ELECTRICAL WORLD

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Coming Features

What Cost Service Outage

Boston Edison Company's W. B. Elmer has devised a method for attaching a dollar value to service outage as a guide to spending money for service reliability. His method will be described in the next issue.

Bus Brazing Technique

A new bus jointing technique that uses brazing to eliminate bolting in the fabrication of heavy laminated copper bus runs has been developed and will be described in an early issue. First used on a bus designed to carry 35,000 amp. at 4 to 5 volts, this technique can also be applied to the higher voltage ranges encountered in substation and generating station bus structures.

Conveyor Control

The second in the current series of articles by George Hall on industrial conveyor systems will soon appear. In this article Mr. Hall discusses the selection and application of electrical controls to conveyors.

On the Cover

An exterior view of Twin Branch station of the Indiana & Michigan Electric Company at Mishawaka, Ind., is on the cover of this issue. A 2,400-lb. superposition turbine being added to this station is described by Philip Sporn in this issue.

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ELECTRICAL WORLD

OCTOBER 9, 1937

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Barring Subsidies, Steam Power is Cheaper

Further evidence of the economy of steam generation of electrical power appears in this issue in the third Steam Station Cost Survey which ELECTRICAL WORLD has made over the past ten years. Coming as it does at the time when President Roosevelt has just concluded a visit to the federal water-power developments of the Northwest, in the course of which he expounded his plan for widespread distribution of electricity from these projects, it serves to emphasize the complete disregard of economics in the Administration's program of regional planning.

The cornerstone of regional planning is cheap power. What constitutes cheap power? In its reports on "Technological Trends and National Policy," the National Resources Committee in June of this year told the President that "the high efficiency and low fixed charges now possible in large fuel-burning plants place hydro-electric developments at a disadvantage in most sections of the United States if low cost is the objective."

The current Steam Station Cost Survey shows that production cost for steam-generated energy runs about 40 per cent of the total, while fixed charges take the other 60 per cent. It is obvious, then, that for hydro power to be generated for less money than steam it must cost less than 1.7 the unit cost per kilowatt of a comparable steam station. While that may once have been possible for the cream of the developments it is highly improbable at the present time.

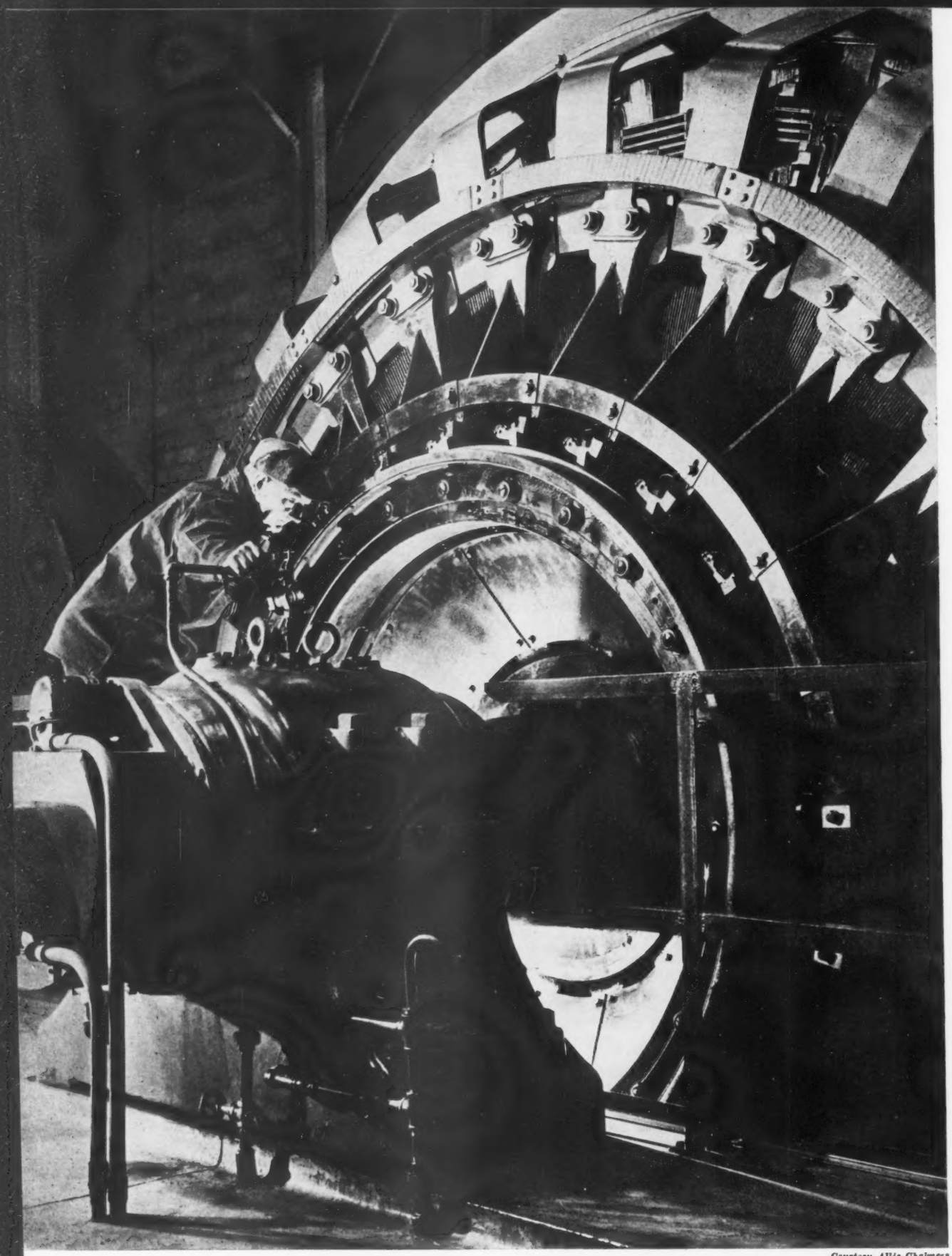
On top of that we find that water-power sites now being developed are remote from consumption areas, while steam plants are naturally located near the load. Add the transmission cost and the gap becomes even greater.

Moreover, the President's committee reported, water power lacks reliability because of floods, low water, ice and other conditions. Steam, on the other hand, our survey shows, is constantly improving in reliability. Steam plants are being used nearer the limit of their rated capacity than ever before.

These hydro projects are built to last for a great many years. The efficiency of hydro generating equipment is close to the 100 per cent mark. Steam efficiency, on the other hand, is constantly improving, so that there is a further opportunity for lowered production costs.

Of course, hydro power can be arbitrarily reduced in cost by shifting fixed charges to some other ledger. If navigation and flood control can be made to absorb a large amount of the cost of dam construction, then hydro power can appear to be reduced in cost.

Such subsidies may bring cheap power, but the public should be made to understand that the cost is there just the same—cost that is greater than that of power from private industry.



Courtesy Allis-Chalmers

MODERN MOTORS FOR MODERN MILLS

One of four 5,000-hp. 110/250-r.p.m., 600-volt, direct-current motors that drive 100-inch semi-continuous sheared plate mills in one of Pittsburgh's steel mills.

Bus Design at Modernized Waterside Features Reliability

Compact, Sturdy, Phases Isolated, Faults Localized, Installation, Inspection and Repair Easy, High Insulation Level, Stresses Balanced, in this Factory-Assembled Bus Structure

By A. M. deBELLIS
Assistant Inside Plant Engineer
Consolidated Edison Company of New York

IN ORDER to provide equipment which would meet necessary requirements in a limited space, such as that available in the Waterside galleries, it was found necessary to develop a new type of bus and switch construction which would embody the following basic features of design:

1. Compactness and sturdiness of construction.

2. Buses should be of the isolated phase and of the metal-inclosed type, with an air space between phase housings to prevent a phase-to-ground short circuit developing into a phase-to-phase short due to physical damage to the housing and also in order to localize mechanical damage and to facilitate installation and repairs.

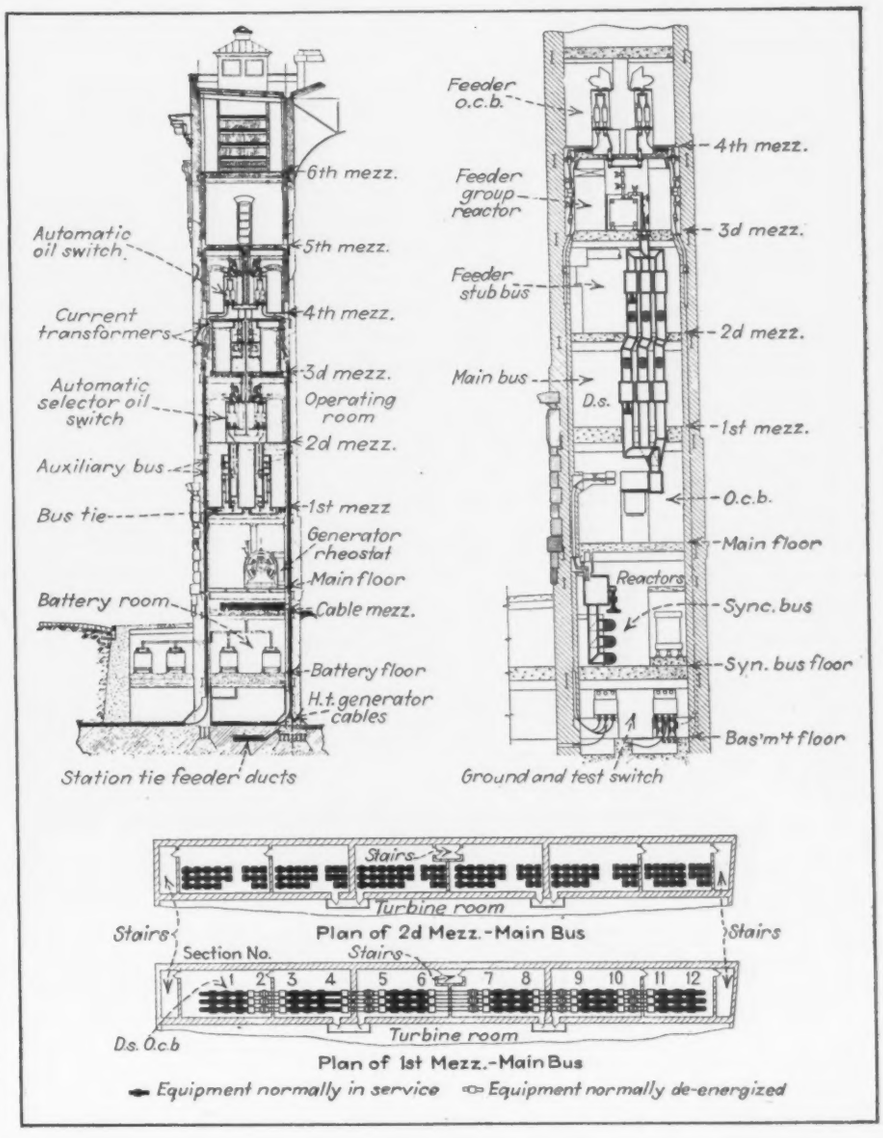
3. Bus housings should not be filled with oil or insulating compound to reduce fire hazard.

4. Buses should have a high insulation level, using a type of insulation which would not be damaged by high temperatures resulting from short circuits and which, at the same time, could readily be repaired or replaced in the field if necessary. Bus conductors should be factory insulated and the number of connections requiring field insulation to be applied when assembling should be kept down to a minimum.

5. All current-carrying parts should be free of corona at rated voltage.

6. Buses should be supported by porcelain insulators of a design which, utilizing the material to its best advantage, would reduce the possibility of damaged porcelain due to mechanical and electrical stresses set up during short circuits.

7. A low-resistance grounding grid



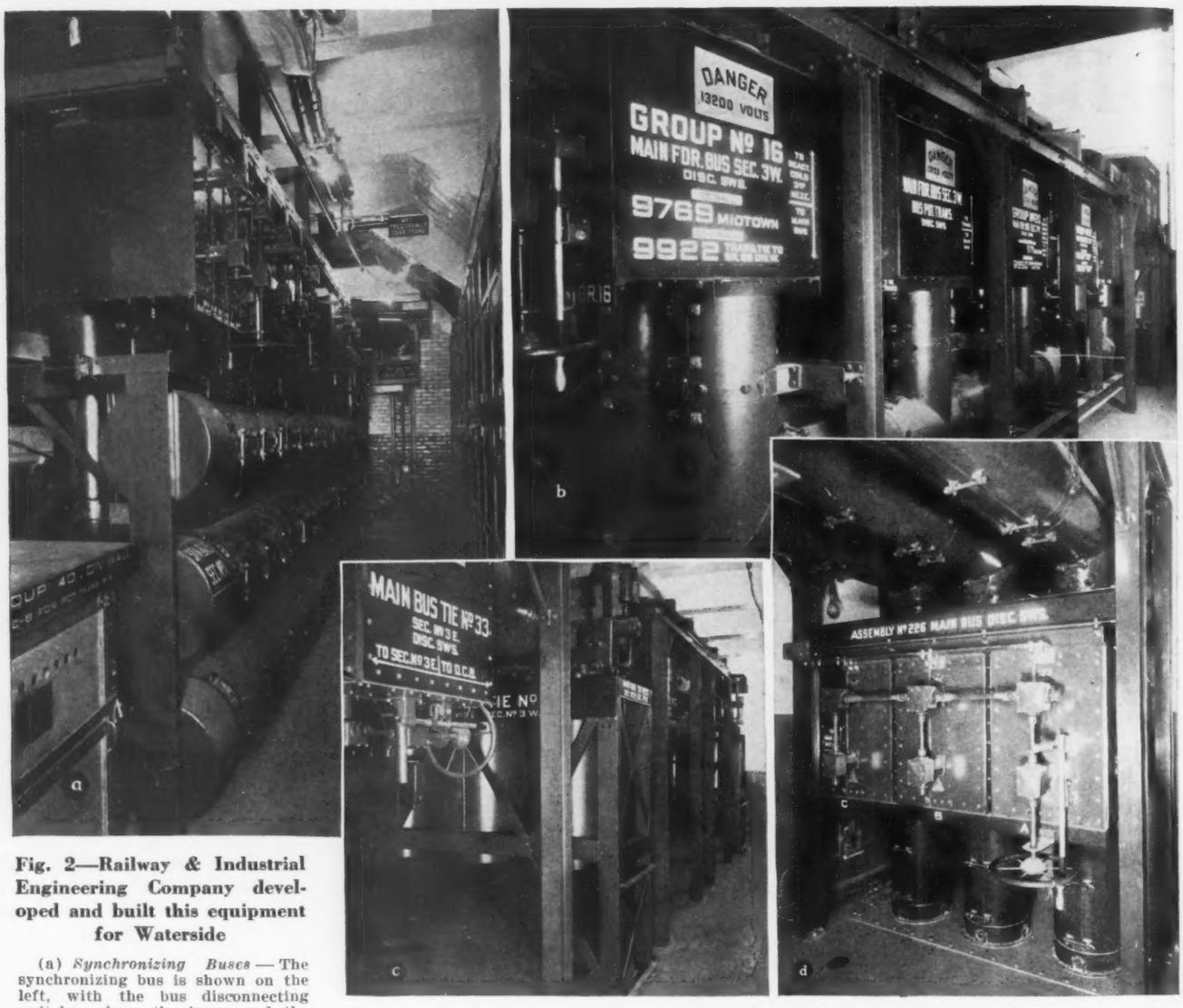


Fig. 2—Railway & Industrial Engineering Company developed and built this equipment for Waterside

(a) *Synchronizing Buses* — The synchronizing bus is shown on the left, with the bus disconnecting switches above the buses and the bus risers in the rear. This design arrangement was dictated by space limitations. The concrete compartments on the right house the reactors for the ties between the main and the synchronizing buses and also the reactors for the frequency changers. A fire wall may be seen in the background. Provisions for future extension of the buses are shown in the left foreground.

(b) *Feeder Stub Buses*—Horizontal arrangement of the feeder stub buses with the group feeder disconnecting switches mounted above them. Metal inclosures for the connections to the group feeder reactors, located on the floor above, may be seen between the ceiling and the top of the supporting structure. The metal inclosure for the connection between the feeder stub buses and the main buses, located on the floor below, is shown in the third bay. A fire wall and a generator oil circuit breaker are in the background.

(c) *Main Buses*—The main buses are mounted on the upper part of the structure and are in line with the sectionalizing bus disconnecting switches, located one on each side of the bus tie oil circuit breakers. With this arrangement only short connections are needed between the main buses and the feeder stub buses. It should be noted, however, that locating the main and feeder buses on two floors rather than on a common floor was again dictated by building limitations.

(d) *Main Bus Tap*—Taken at a point where the main bus is tapped, through a sectionalizing disconnecting switch, for the connection to the synchronizing bus equipment which is located on the floors below.

should be provided capable of carrying safely the fault currents and arranged so that it would provide for these currents a direct channel to the main station ground, thereby reducing the serious operating hazard of damaged control and secondary wiring due to stray currents in the building structures.

8. Buses and associated inclosures and equipment should be designed so that they could be readily installed, inspected or repaired. By requiring a minimum of installation labor, full advantage could be obtained of the benefits of factory-assembled equipment.

Service reliability was, of course, the primary consideration in the physical sectionalization of the oil circuit breakers and buses. Likewise, it was the primary consideration in selecting the design and type of construction for the buses and switching equipment.

A study which included considerations of service reliability, safety to personnel, convenience of operation and the increasing costs of labor and materials indicated that some form of metal-inclosed buses and switches requiring a minimum of installation labor and maintenance should be selected.

Before proceeding to describe and discuss the features of the modernized electrical galleries at Waterside it will be desirable to describe the history and recent status of the galleries. The Waterside No. 2 electrical galleries occupy a section of the station building 13 ft. 6 in. wide by 306 ft. long. Built in 1905 for an ultimate capacity of 106,000 kw., these galleries were designed primarily to supply a 6,600-

volt, 25-cycle system. The switching scheme of connections was of the familiar "H" type, using a main and auxiliary bus with two selector and two feeder oil circuit breakers per group. Masonry compartments were used throughout.

When toward the end of 1923 the New York Edison Company embarked on an extensive program of changing the generation and transmission voltages of the 25-cycle system from 6,600 volts to 11,400 volts changes in the switching equipment were made to meet the higher voltage requirements and the increased duty imposed upon the equipment. These changes, however, were not radical ones and the main design features were maintained.

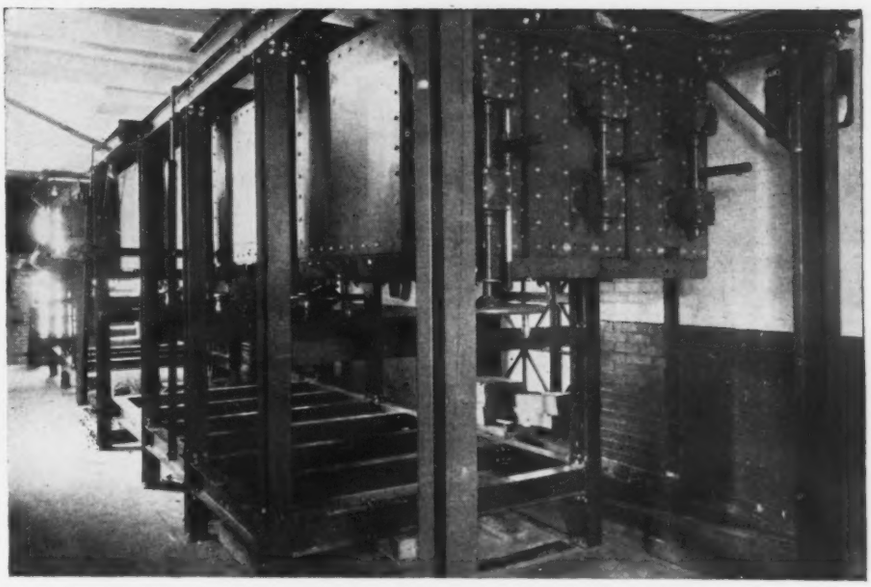


Fig. 3—Framework and disconnects for feeder stub buses

High-duty breakers segregated

In the modernization program now under way new requirements dictated by past experience and by advancements in the art have resulted in an extensive revamping of the galleries, which are being converted to 13,200 volts, 60 cycles with an ultimate capacity of 312,000 kw.

A one-line diagram showing the bus and switch connections selected for the 60-cycle, 13,200-volt equipment, together with a description of the physical sectionalization of the galleries, appeared in the article by H. D. Braley in ELECTRICAL WORLD of September 25, 1937.

Location of fire walls on the floors shown on page 63 is typical for all floors.

Sectionalizing the galleries by means of fire walls segregates the high-duty breakers which are connected directly to the buses and which have relatively large quantities of oil, into small groups, thereby reducing the fire hazard.

On the first mezzanine only two breakers are located in any one room, and of these one breaker is normally open.

On the second mezzanine one generator breaker only is located in any one room, while on the main floor, which houses the automatic breakers for the connections between the main and the synchronizing buses, only two such breakers are located in any one room.

The bus construction consists of a fabricated steel-supporting structure on which are mounted the disconnecting switches and the bus insulator assemblies which carry the buses. A partial view of the synchronizing bus assembled at the factory of the Railway & Industrial Engineering Company was shown on page 24 of the July 31, 1937, issue of ELECTRICAL WORLD. The installed framework and disconnecting switches for feeder stub buses are shown in Fig. 3.

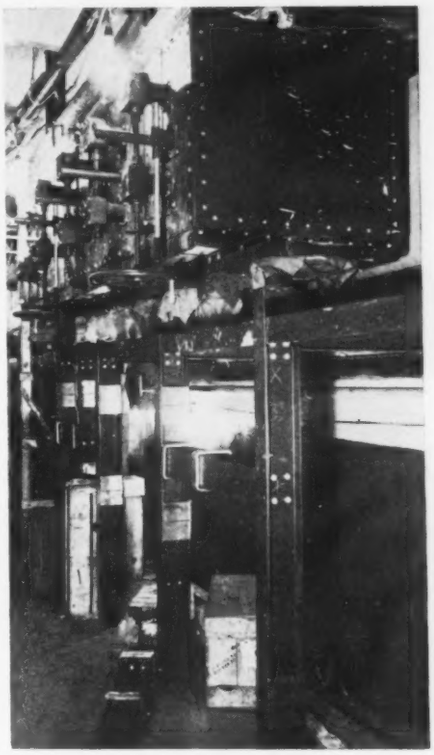


Fig. 4—Eddy currents problem in only a few situations

Use of steel for the supporting structure was found to be entirely satisfactory from the standpoint of heating, and only in the synchronizing bus, due to the compactness of the layout, was it found necessary to use some short-circuiting copper straps and a few members of non-magnetic material as shown here.

Bus insulator assemblies, shown in detail in Fig. 5, are the main members designed to take the strains during short circuits and consist of aluminum-bronze ring castings equipped with four porcelain insulators mounted at 90 deg. from each other, for holding the buses in place.

One type of insulator assembly design is used throughout and all insulator assemblies are interchangeable.

Insulation used to best advantage

The arrangement of bus supports (Fig. 5) together with the elimination of hardware as an integral part of the porcelain insulators and the use, for mounting purposes, of a single adjustable element of the ball-socket type for each insulator, increases the safety factor of the bus because the insulators are used to their best advantage, being subjected essentially to compression stresses.

Destructive mechanical forces which may be caused during short circuits by mechanical oscillations set up in bus supports which are clamped to the buses and bolted to the supporting structures, and which are, therefore, subjected to cantilever stresses, are greatly reduced.

It was with a view to reducing as much as possible the shearing stresses in the porcelain that four insulators were used and mounted at 90 deg. from each other so as to take direct compressive loading.

The use of porcelain insulators without attached hardware has also simplified manufacturing and has permitted the use of a more compact design.

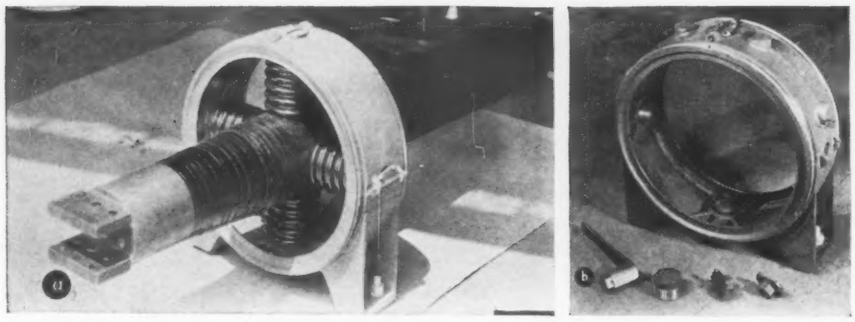


Fig. 5—Bus insulator assemblies take short-circuit strains

Aluminum-bronze ring castings. No hardware attached to porcelain insulators. Each insulator is made to bear against the bus by an adjustable screw adapter held by the insulator ring and which, in turn, bears against the cupped base of the insulator. A lead disk is inserted between the porcelain and the adjustable adapter and provision is made to lock the adapter in place so as to prevent loosening of the insulator.

In addition, this arrangement of bus supports greatly simplifies the assembling and lining up of the buses because all insulator adjusting and locking in place is done from the outside of the insulator rings. Likewise, for maintenance purposes, tightening up of insulators, if necessary, could be done from the outside of the bus inclosure.

The bus housings, one for each phase, are, in the case of the main and synchronizing buses, spaced 25 in. on centers and consist of cylindrical, split covers of 16 in. diameter, bolted together and clamped to the insulator supporting rings.

Longitudinally, when the two halves of a housing are bolted together, they are brought to bear against and to engage in the opposite slots of an extruded H-section in which a gasket has been inserted. Likewise, gaskets are provided on the clamping surfaces of the insulator rings.

All covers are made of 3/16-in. material, manganese steel being used for straight sections and a copper silicon alloy being used for all fabricated members, such as elbows, tees and crosses.

Circuit eddy losses in the bus housings are controlled by insulating one end of the housings from the supporting rings. Local eddy losses in the housings are negligible.

The length of the bus housing sections is determined entirely by the location of the bus supports and the maximum lengths used in Waterside vary from 4 to 5 ft. This type of clamped and gasketed construction has greatly facilitated the installation work due to the fact that no accurate field fitting of the covers is necessary.

From an operating standpoint, it is expected that the use of dust-tight housings will greatly reduce maintenance and facilitate operation because cleaning of the equipment will probably be scheduled on a yearly basis.

From the standpoint of manufacturing costs, it appears that this type of bus inclosure construction offers possibilities for standardization. Any bus layout becomes, to a large extent, an assembly of standard parts such as insulator rings and cover fittings consisting of elbows, tees, crosses and straight lengths.

The ground grid consists of 4 x $\frac{1}{4}$-in. copper bars mounted between the supporting structure and all bus insulator supporting rings and disconnecting switch housings. The various copper bars then terminate to a ground bus which is part of the metal-inclosed equipment and which in turn connects to the main station ground. This location of the copper bars on the face of the supporting steel structure is clearly shown in Fig. 4.

Main and synchronizing buses are rated 3,000 amp. and are made of 5-in. O.D. copper tubing with a wall thickness of 0.450 in.

Fittings for elbows, tees and terminals are of cast bronze and shrink-type connections are used throughout, with the exception of field connections, which consist of bolted copper straps, either rigid or flexible, inclosed in cast bronze corona shields. Tests made on these shrink-type connectors show a high mechanical strength and a high electrical conductivity. All such connections are subjected to a routine electrical test at the factory.

All straight lengths of bus conductors are machine-wrapped to a thickness of $\frac{3}{8}$ in. with varnish cambric

[*Continued on page 138*]

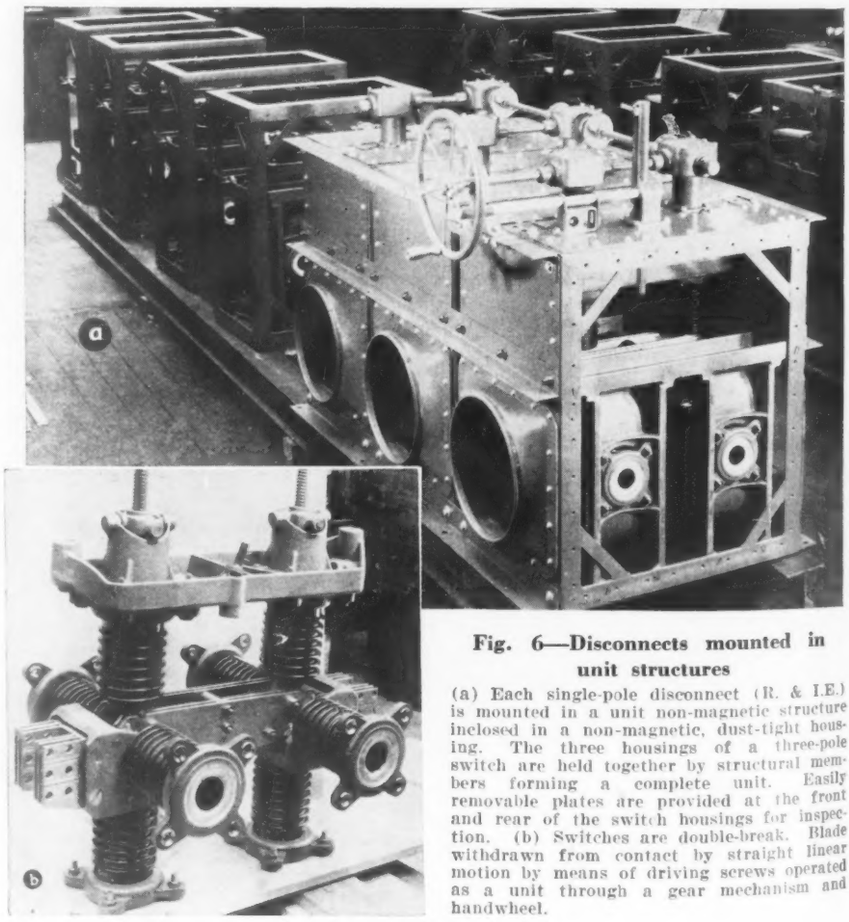


Fig. 6—Disconnects mounted in unit structures

(a) Each single-pole disconnect (R. & I.E.) is mounted in a unit non-magnetic structure inclosed in a non-magnetic, dust-tight housing. The three housings of a three-pole switch are held together by structural members forming a complete unit. Easily removable plates are provided at the front and rear of the switch housings for inspection. (b) Switches are double-break. Blade withdrawn from contact by straight linear motion by means of driving screws operated as a unit through a gear mechanism and handwheel.

Gate Bridge Lighting Has Preassembled Standards

I-Beam Lighting Standards With Sodium-Vapor Luminaires —Four Separate Sources of Power Supply Bridge Circuits

NEWEST section among America's growing networks of lighted highways is the aerial thoroughfare, 9,200 ft. long, bridging San Francisco's Golden Gate. To light its six-lane automobile highway 10,000-lumen sodium-vapor luminaires have been selected.

The total number of sodium-vapor luminaires is 214, of which 199 are used on the bridge and approaches and the remainder in the Waldo tunnel, which forms the northern approach through the Marin hills. These units, placed opposite at average distances of 150 ft., are installed at a uniform height of 25 ft. above the roadway surface. The installation, made by the Alta Electric & Mechanical Company, San Francisco, which also designed the standards, embodies interesting features of electrical practice. Conduits for the bridge electrical circuits are carried in a recess which is a portion of the sidewalk. Pull boxes are located at the points where standards were to be installed. The standards were fabricated in San Francisco complete with the conduit carrying the wiring from the luminaire to the base. Then they were delivered to points along the roadway where they were to be installed and there equipped with the lighting units and all electrical wiring, including the series transformers. Studs with double-adjusting nuts were set in the concrete when the sidewalk was laid, materially simplifying both the installation and the leveling of the standards.

Lighting standards of modernistic tone were fabricated from 10-in. I-beams

I-beams are split at one end, spread and turned to form a jaw into which the sodium-vapor luminaire is installed. The lighting standard and luminaire, completely wired up, is hoisted into position and quickly bolted into place. Connection of the primary leads from the series transformer to the bridge lighting circuit is all that is necessary to put the lamp in operation.

Power supply for the bridge

The main substation for the bridge is located in the toll plaza building on the San Francisco side. From this point are served the six main electrical circuits providing (1) energy, or control for the supervising circuit on navigation equipment, (2) emergency telephone circuits, (3) foghorn control and feeders, (4) lighting circuits on the bridge, (5) power circuits on the bridge, and (6) navigation light power circuit. Of the four sources of energy, two are separate 11-kv. feeders from the Pacific Gas & Electric Company system, each supplying a set of transformer banks. In case of complete loss of central station service a 187½-kw. gas-engine-driven set is connected to start automatically and pick up all the electrical equipment on the bridge except the toll plaza office section, electric heating load and the five roadway circuits. Power for cranking the engine is provided by a storage battery, which acts as the fourth source of power for emergency lighting at the toll plaza if all three others fail. A time-delay throw-over switch connects the battery to emergency circuits in that case. The transformer vault in the San Francisco toll plaza contains two banks of 300-kva., 11,000/2,300-volt transformers, four 20-kw. constant-current transformers, two 7½-kw. constant-current

[*Continued on page 155*]

Three Years of Load Building

Facts and Figures of 28 Operating Companies of the Middle West System Provide Answers to Many Current Questions on Modern Load Building

EARLY in the panic period of the '30s management forces of the public utility companies foresaw the pressing need for building loads to utilize the capacity installed and operating at that time. The only way to keep the companies operating, to meet payrolls and cover fixed charges was to hold on to revenues, to restore revenues and to find new sources of revenue.

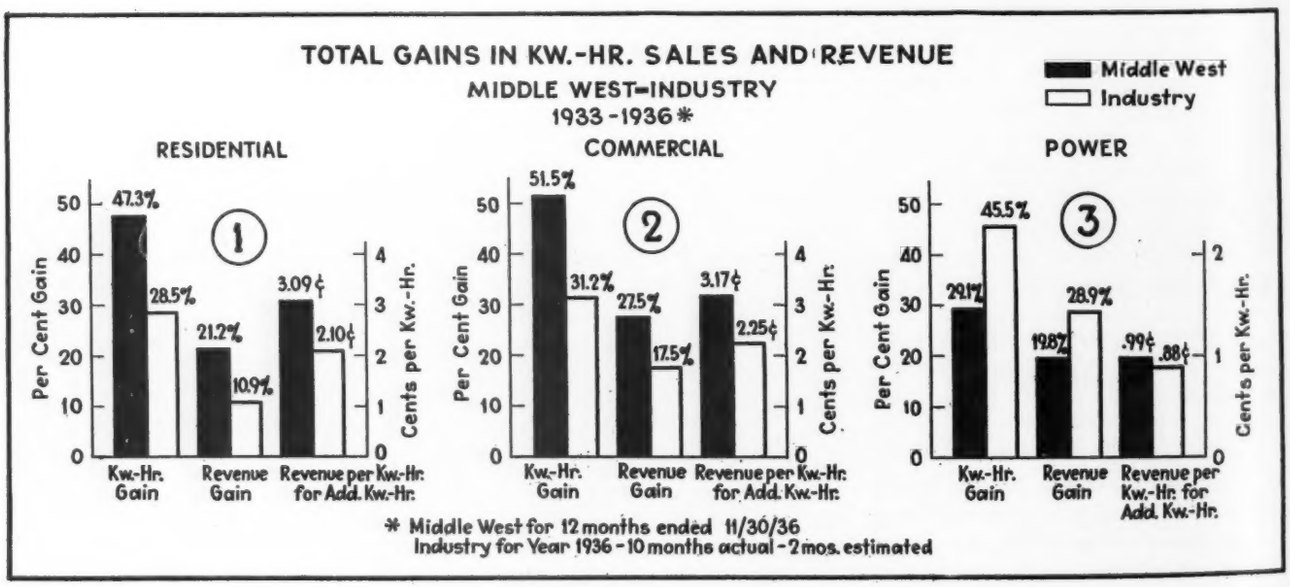
It was under such circumstances that the load builder jumped into the saddle and out of these efforts load building has reached its present momentum and importance.

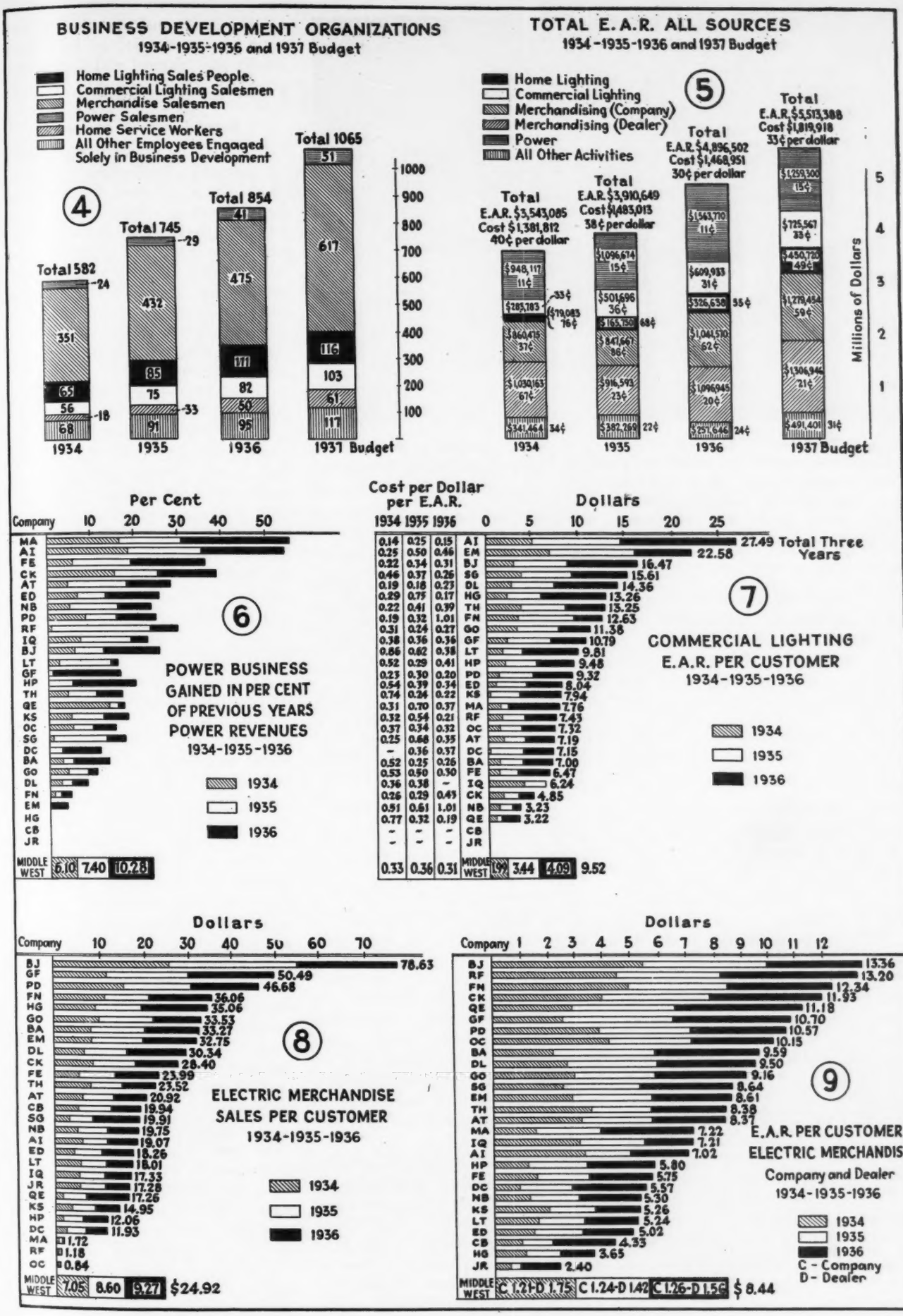
Subject of much interest and discussion in the industry, load building also raises many questions. By and large, the utility company is trying to adopt a new sales viewpoint and build more of that kind of load which can be sold at a price that covers all the costs of the science. Thus, there are and will continue to be many questions about the number of employees needed for load-building activities. How many are necessary for power sales, for merchandise sales, or for home lighting? How much E.A.R. is to be expected from the various groups? How much should it cost per dollar of E.A.R.? How should added load be balanced?

What are the possibilities of the home market? How much can reasonably be expected from dealer organizations? These and a host of other questions are discussed at sales meetings, by intercompany groups and at sales conferences, but the best answers are those based upon first-hand experience.

It is to meet these needs that ELECTRICAL WORLD has endeavored to compress into a few pages of this issue and a succeeding issue a graphic presentation of the load-building accomplishments in the last three years of the 28 operating companies in the Middle West group. The story is based upon a summary prepared by V. H. Moon, vice-president of the Middle West Service Company, for a recent meeting of sales and operating executives of the companies and is presented here by permission of Mr. Moon and of D. C. Green, president Middle West Corporation.

Credit for the accomplishment that is shown here must be given almost entirely to the managements and sales personnels of the operating companies. It was they who translated into vigorous and effective action the suggestions from the Middle West Service Company, applying those suggestions in the manners best adapted to local problems and conditions and frequently improving on them as their possibilities developed. It was the operating companies who did, and




BUSINESS DEVELOPMENT ORGANIZATIONS
1934-1935-1936 and 1937 Budget
Home Lighting Sales People
Commercial Lighting Salesmen
Merchandise Salesmen
Power Salesmen
Home Service Workers
All Other Employees Engaged Solely in Business Development
4
Total 582
Total 745
Total 854
Total 1065
1934
1935
1936
1937 Budget
TOTAL E.A.R. ALL SOURCES
1934-1935-1936 and 1937 Budget
Home Lighting
Commercial Lighting
Merchandising (Company)
Merchandising (Dealer)
Power
All Other Activities
5
Total E.A.R. $3,543,085 Cost $1,381,812 40¢ per dollar
Total E.A.R. $3,910,649 Cost $1,483,013 38¢ per dollar
Total E.A.R. $4,896,502 Cost $1,468,951 30¢ per dollar
Total E.A.R. $5,513,388 Cost $1,819,918 33¢ per dollar
Millions of Dollars
Per Cent
Company
6
POWER BUSINESS GAINED IN PER CENT OF PREVIOUS YEARS POWER REVENUES
1934-1935-1936
1934
1935
1936
MIDDLE WEST 6.10 7.40 10.28
Cost per Dollar per E.A.R.
1934 1935 1936
Dollars
Total Three Years
7
COMMERCIAL LIGHTING
E.A.R. PER CUSTOMER
1934-1935-1936
MIDDLE WEST 0.33 0.36 0.31 3.44 4.09 9.52
Dollars
8
ELECTRIC MERCHANDISE SALES PER CUSTOMER
1934-1935-1936
MIDDLE WEST 7.05 8.60 9.27 $24.92
9
E.A.R. PER CUSTOMER ELECTRIC MERCHANDISE
Company and Dealer
1934-1935-1936
C - Company
D - Dealer
MIDDLE WEST C 1.21-D 1.75 C 1.24-D 1.42 C 1.26-D 1.56 $ 8.44

BALANCED LOAD BUILDERS—D. C. Green (left), president Middle West Corporation, and V. H. Moon, vice-president Middle West Service Company

"The operating utility executive has two major reasons for load building," says Mr. Green. "One is that he should do his job in bringing the values and benefits of electric service to the people. The other is that with taxes, payrolls and all other costs going up, net revenue has no other source than new load. Without net revenue, there will be no money for system growth.

"Firm conviction that load building is a large and essential element in successful operation of electric utilities was a principal article of our faith when Midle West was reorganized. The events of three years application of this belief, as set forth here, demonstrate the soundness of the conviction. Yet what has been accomplished is only an indication of what can be done, and we believe that more money and more effort intelligently employed in load building will show much greater results."

"Balanced load building means building profitable load at reasonable cost at a satisfactory pace and with constantly improving trade relations," Mr. Moon declares. "This is the philosophy of Middle West load building. The total result, the average condition, has justified the program and we are confident that any exceptions will disappear as the program continues. Certainly the program is justified by the comparison of E.A.R. with actual revenue increase in the three-year period. In spite of rate reductions, increases in number of low-use customers and other modifying factors, the increase in revenue is within 6 per cent of what it was estimated the new load would add."

are continuing, this load-building job. All that was attempted by the supervisory direction in the service company was to set up guide posts to show the way.

Three major considerations make this story of interest at this time: First, it emphasizes the value of planned utility load building to the homes and business of the nation; second, by reference to charts 1, 2 and 3 it will be seen that on the E.A.R. basis used in computations the group under consideration has been a great social influence in its far-flung territory, and, third, this is not a story of plans or projects or hopes or aims, but is a detailed report of the results of three years of work. Load building cost, as the term is used in this article, covers merchandising losses, interest on merchandise accounts receivable, interest on merchandise stores and all charges to new-business accounts, originating in company merchandising activity.

The 28 electric utilities represented here are scattered geographically over a large ara and the story they tell is of the zealous promotion of electric service in the smaller cities, the towns, villages, hamlets and countryside of this nation. No large metropolitan centers nor any highly industrialized areas appear in this picture; it is instead the picture of electric service to the people in their homes and in their local business places and factories.

The greatly increased uses of electricity shown by these graphs did not result directly and alone from the availability of electric energy at low rates which exists on the Middle West system. On the contrary, low-cost electricity is the least essential element in the growth of energy usage; as the charts indicate, this element must be accompanied by hard work intelligently planned and competently organized.

General results analyzed

In chart 4 is shown the growth of the business development organizations of the companies * comprising the Middle West system. In 1933 there were 266 employes of operating companies devoting their entire time to load building. Year by year there has been steady growth in the business development organizations, and today there are 1,065 employees devoting their entire time to business development of some type.

In 1934 operating companies reported $3,543,000 of new load added at a cost of 40 cents per dollar of new revenue, as shown on chart 5. Of this amount a little over $1,000,000 in E.A.R. resulted from dealer sales of merchandise, $79,000 from home lighting, $283,000 from commercial lighting and power sales accounted for $948,000. Total E.A.R. shows a substantial increase each year and cost per dollar of E.A.R. a continuing decrease, in spite of the fact that E.A.R. from company merchandising and dealer merchandising per unit has been substantially lowered.

It is possible that the E.A.R. indicated in 1935 from company and dealer merchandising is higher than was actually experienced. The average E.A.R. assigned to an electric range in 1934 was $43. In 1935 it was $34.60, and still further reduced to $33.70 in 1936. Electric refrigerators were estimated as producing E.A.R. of $31.30 in 1934, whereas in 1935 this estimate had been reduced to $22, and further reduced in 1936 to $21.58. Refrigerators account for a very large part of the total E.A.R. from company and dealer merchandising. Consequently a reduction of $10 per unit, or one-third, had the effect of substantially reducing the E.A.R. shown in 1935 and 1936, in comparison with 1934.

Note that in the three years 1934, 1935 and 1936 there has been no great increase in the E.A.R. reported from company and dealer merchandise sales. The cost per dollar of E.A.R. in dealer sales is company cost and

[*Continued on page 151*]

* The designations of companies in this and the other charts have no significance except as supplying a continuing identification throughout this presentation.

Phase-Angle Control Solves Interconnection Problem

By ELWOOD A. CHURCH
Engineering Department, Boston Edison Company

ECONOMIC studies in connection with the supply of power from the New England Power Association's Tewksbury substation to its North Boston properties indicated that it would be to the mutual advantage of the Boston Edison and the New England Power systems initially to supply this area by a single-circuit, 110-kv. line from Tewksbury to Melrose, with an emergency tie to the Boston Edison System via three 24-kv. cables which originally formed a part of the supply to the North Boston area. This saved the investment of a second circuit from Tewksbury to Melrose and, at the same time, gave an additional interconnection between Boston Edison and New England Power for the supply of primary and secondary power to Boston Edison or for mutual support in emergencies

In order to control independently the flow of power and reactive kva. and to prevent overloads on the various lines comprising the new connection phase-angle and voltage adjustment was necessary, since the connection forms part of a loop through the Edison and the New England Power systems, as shown in Fig. 1. It is the purpose of this article to describe the various factors involved in the installation of the phase-angle and voltage adjustment in the new interconnection. A view of the equipment appeared on page 38 of the ELECTRICAL WORLD of July 17, 1937.

Basic elements of problem

A study of phase-angle and voltage adjustment in an interconnection should include the following:

1. Costs of locating the adjusting transformers in various links of the interconnection. In general, the transformers should be located in the link of lowest capacity in order to keep down the necessary carrying capacity of these transformers and, hence, the cost.

2. The total range of phase-angle and voltage adjustment required to take care of all conditions of power flow in the loop must be determined for all probable loca-

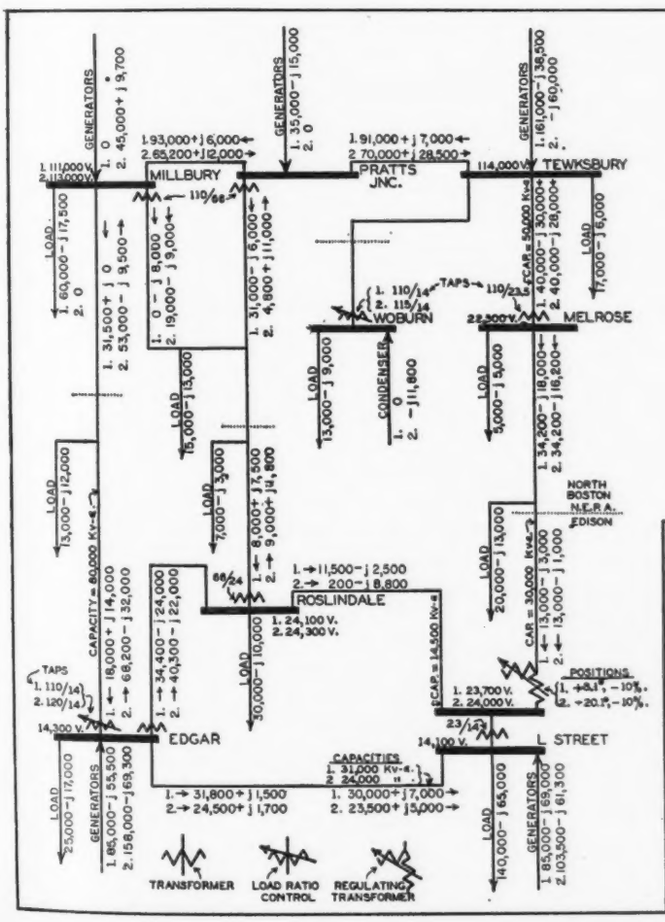


Fig 1—Connection and power flow diagram of Boston Edison-New England Power Ties—(1) Hydro, 11 a.m. spring weekday. (2) Steam, 3 p.m., fall weekday

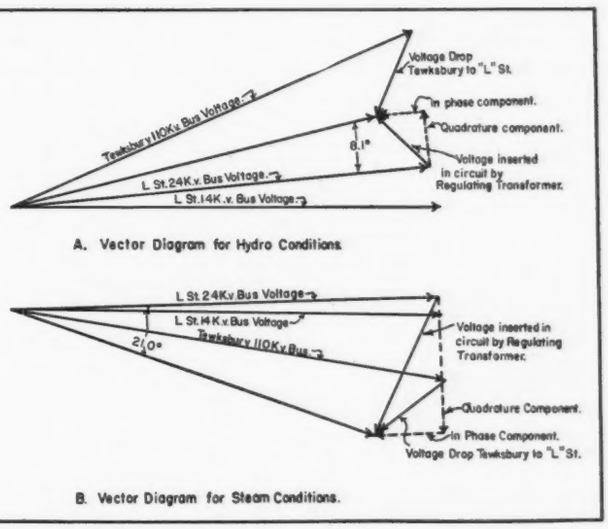

Voltage Drop Tewksbury to "L" St.
In phase component.
Quadrature component.
Tewksbury 110Kv Bus Voltage
L St. 24Kv. Bus Voltage
L St. 14K.v. Bus Voltage
Voltage inserted in circuit by Regulating Transformer.
A. Vector Diagram for Hydro Conditions
L St. 24Kv Bus Voltage
L St. 14 Kv Bus Voltage
Tewksbury 110Kv Bus
Voltage inserted in circuit by Regulating Transformer.
Quadrature Component.
In Phase Component.
Voltage Drop Tewksbury to "L" St.
B. Vector Diagram for Steam Conditions.

Fig. 2—Voltage vectors at Tewksbury and L Street for conditions of Fig. 1

tions of the equipment. In a simple loop the amount of phase-angle adjustment required is independent of its location, but the voltage (in-phase component) control required may vary, depending upon voltage requirements at various terminal points. In some systems there may be a loop within a loop, in which case any control of the outer loop must be located in some link outside the inner loop to control independently the power flow. In order to control completely both loops phase-angle adjustment may also

be required in the inner loop. However, in the majority of cases, if adjustment of the inner loop was not necessary previous to the interconnecting of the outer loop, it will not be required afterward. In a large number of cases the installation of reactors in an inner loop will improve the load division, especially if there are no generating stations within it. Probably provision for sufficient range of phase-angle or voltage adjustment to control completely the power flow during certain infrequent operating conditions will not be economically justified, in which case these conditions may be eliminated in determining the range of the equipment.

3. Methods of control should be studied. The equipment should be located in proximity to a generating station if practicable from an economic standpoint, so that the generator output and phase-angle adjustment may be made by the same operator if manual control is decided upon. Automatic tie-line control for operating the phase-angle adjusters may be justified in certain cases. In the case described in this article manual control is used, and fortunately one terminal of the least capacity link in the interconnection is located at the Edison L Street generating station in Boston, where the adjusters could be governed from the generator operating room. The power flow over the interconnection can thus be easily adjusted in conjunction with the generator output at this location. The system despatchers are also located here.

If the system to be studied is complicated with many generating stations and interconnecting ties an a.–c. calculating board or network analyzer will save hundreds of man-hours of labor in calculating the magnitude and phase of the voltage vectors at the various interconnecting points. If a calculating board is not available a cut-and-try process (described on page 112) may be followed. This method may be expected, without a great amount of labor, to give results within 1 per cent, which is usually more accurate than the line constants and loads from which the calculations are made. Readings taken on the actual system being studied for various conditions of power flow are helpful as a starting point for such calculations.

In the initial studies for the regulating transformers described in this article the network analyzer at the Massachusetts Institute of Technology was used, supplemented by computations using the method described elsewhere in this issue (page 112).

Boston-N.E.P. conditions

There are at present four (including the one in which the phase-angle and voltage control is located) interconnecting points (Fig. 1) between the Boston Edison and the New England Power systems. The Boston Edison Company buys both primary and secondary power over these connections, and sells secondary power.

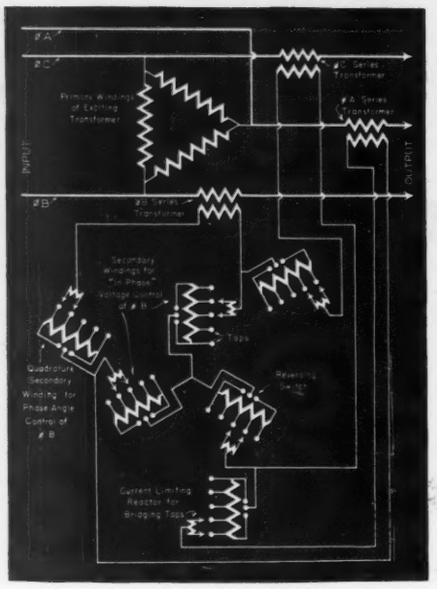


Fig. 3—Wiring diagram for regulating transformers

At times of high water on the New England Power System the flow of power over these connections is such that the North Boston connection would be overloaded if phase-angle adjustment were not provided. The phase-angle adjustment required to limit the load to the transformer capacity at Melrose is shown in Fig. 2a. At times of low water, when the Boston Edison Company is selling steam power to the New England Power Company through the Millbury connection, power tends to flow out over the North Boston connection, which is undesirable from an economic standpoint. The phase-angle adjustment required to maintain maximum generation at Edgar, the most economical station, is shown in Fig. 2b. The flow of power on the various links of the loop for these two of the most important conditions studied is shown in Fig. 1. Another condition which required 20 deg. of phase-angle adjustment was at midnight, with light loads and high water on the New England Power System and with generation at Edgar and L Street at a safe minimum for adequate system protection.

In order to provide a margin for future operating conditions it was decided to install 25 deg. of phase-angle control in both directions from neutral.

Range of voltage control required was determined by the flow of reactive kva. on the Roslindale-L Street lines and North Boston connection and the voltage levels to be maintained at the North Boston substations.

The fact that the North Boston nominal voltage is 23 kv., whereas the corresponding Edison voltage is 24 kv., made necessary a greater voltage range than if both systems operated at the same voltage level. This difference in voltage level was desirable previous to the closing of the loop, as power flow was always toward North Boston. However, with power flowing from North Boston to L Street, voltage adjustment is necessary to prevent a heavy flow of reactive kva. to North Boston, thus penalizing the Edison System.

Since with the method of phase-angle control employed—namely, the insertion of quadrature voltage in the circuit in each phase—the line voltage is automatically increased 10 per cent at the full 25 deg. phase-angle tap, a 20 per cent range of voltage adjustment is necessary to obtain the required net decrease of 10 per cent.

Description of apparatus

The apparatus installed consists of three three-phase, 10,400-kva., 24,000-volt phase-angle and voltage-adjusting transformers, one in each of the three lines composing the North Boston connection at L Street station. Each unit is equipped with conservators, is integral with the line and is protected by the line relays. They are connected into the cable with inclosed, oil-filled-type potheads, eliminating all exposed wiring. A schematic wiring diagram is shown in Fig. 3.

Thirty-two steps are provided in the 50 deg. range of phase-angle adjustment, giving about 1½ deg. per step. This causes a change in power flow in the loop of approximately 2,000 kw. per step.

Thirty-two steps are also provided in the voltage adjustment, giving 1¼ per cent of nominal voltage per step.

Tap changing in the phase-angle adjustment is accomplished by means of an oil circuit breaker, and in the voltage adjustment by a quick-break mechanism operated under oil by means of a combination spring-and-motor drive. All taps are bridged by current-limiting reactors of such capacity that they may be operated continuously with two adjacent taps bridged, thus providing two steps per tap. All current-carrying parts in the tap-changing mechanism are of such capacity that 30 per cent overload may be carried at zero degrees ambient.

Control wiring is carried in ducts to a bench board opposite the generator control board in the operating room at L Street station. Control switches for tap changing for each independent unit and master control switches for operation of all three units together are provided. Meters showing power and reactive kva. flow in each unit are located above the control switches. Selsyn type tap-position indicators are provided on the bench board operated by the position indicators on each individual unit.

The installation has been operated practically continuously since February 26, 1937. Troubles have been minor, consisting of some control relay difficulties and troubles with the Selsyn position indicators.

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THIRD

Steam Station Cost Survey

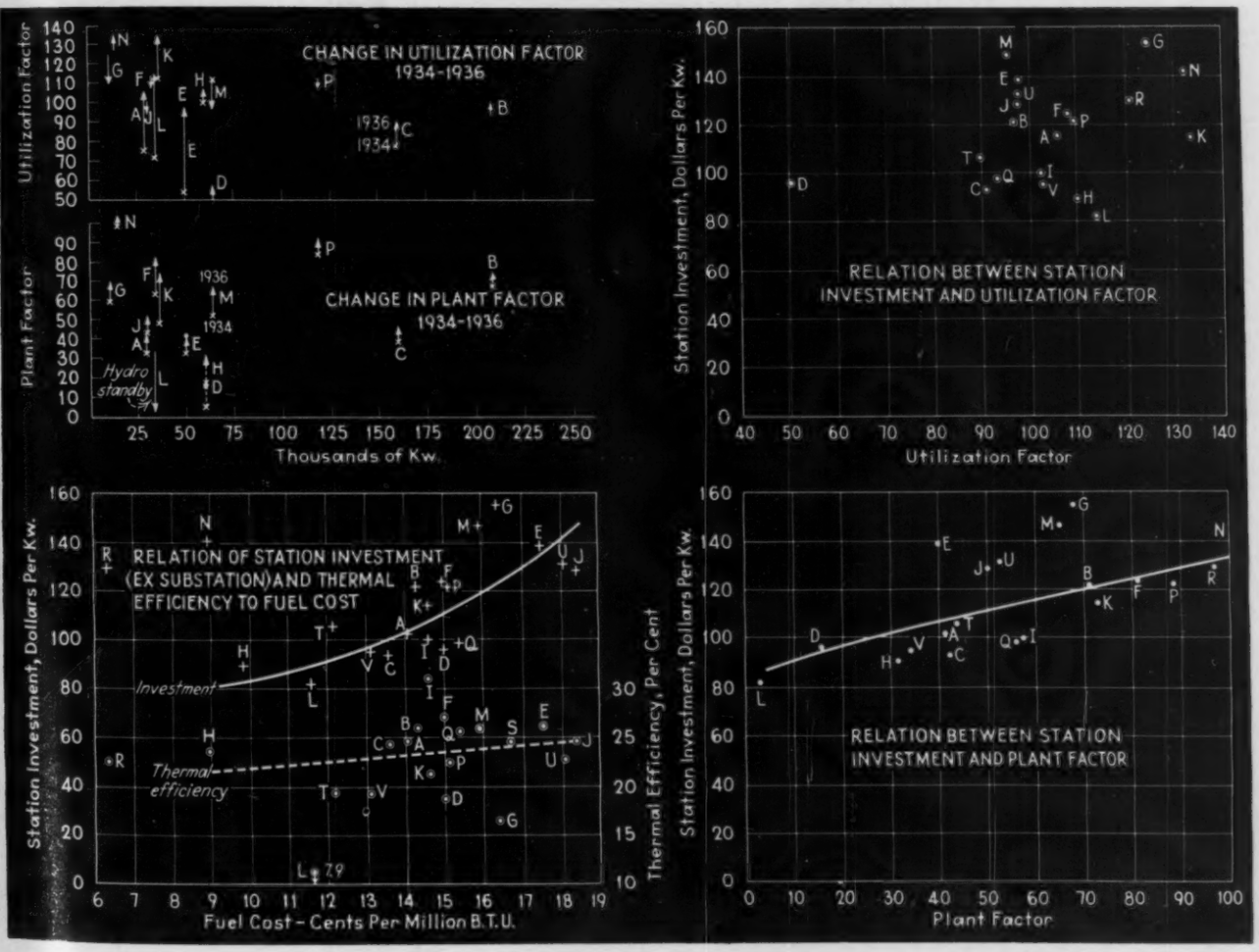
Favorable Loads Run Utilization of Capacity Up to Unprecedented Levels—Two-Year Trend Toward Lower Operating and Fixed Costs for 21 Representative Plants

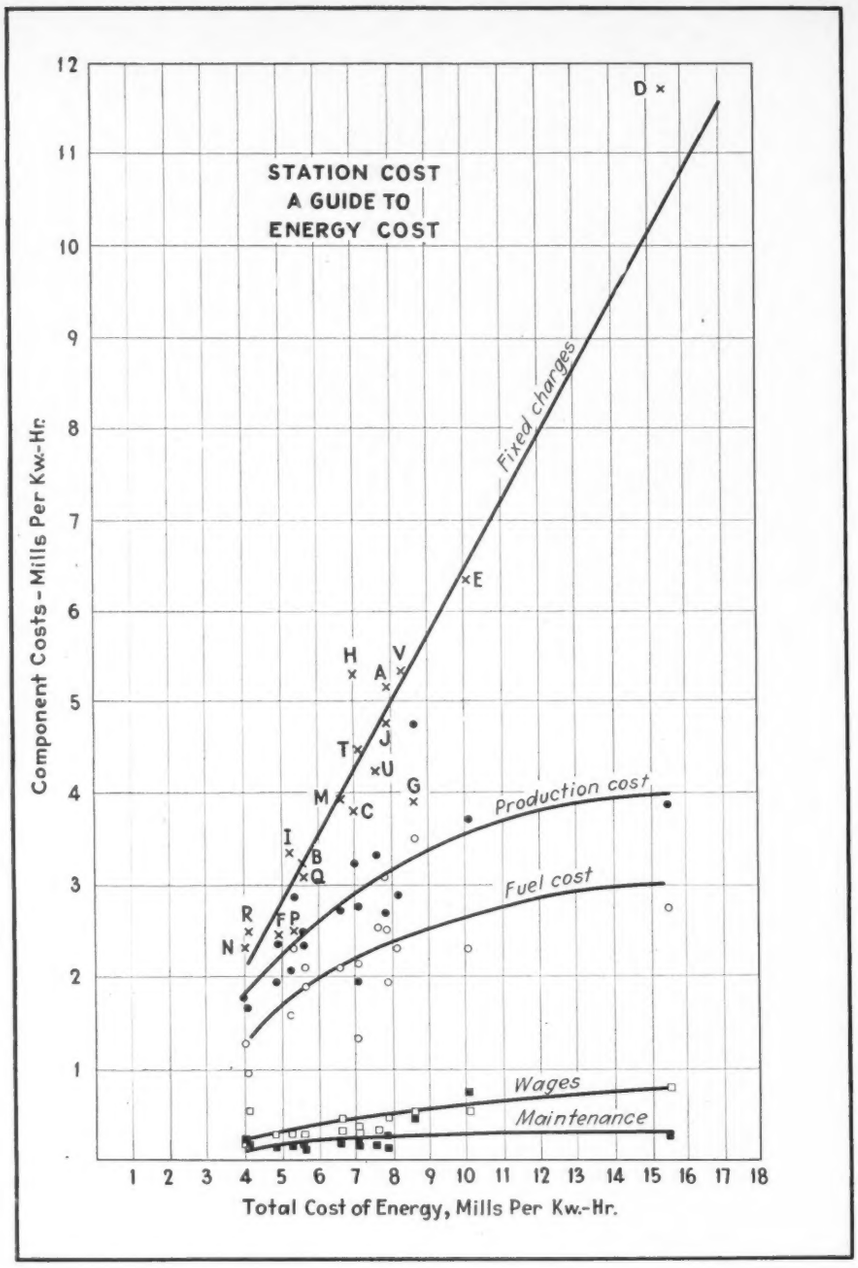
By A. E. KNOWLTON
Associate Editor, ELECTRICAL WORLD

LOADS on utility systems have grown so markedly that the fixed charge and operating components of energy cost have been altered substantially during the last two years. Fortunately the changes have been toward lower values than those reported in the 1935 survey of steam station costs (ELECTRICAL WORLD, November 23, 1935). Practically all indexes reflect advantageous changes, especially those affecting the spread of fixed charges over an increased output in kilowatt-hours per kilowatt of capacity. Steam generation at load centers thus continues to sustain its steady gain in superiority over remote hydro developments entailing high costs per kilowatt.

Data tabulated and charted herewith are for the year 1936 as experienced in 21 stations ranging in size from 15,000 to 300,000 kw. and using all common forms of fuel. The stations identified by letters A to P are the the same ones as identified by the same letters in the 1935 résumé.

Plants were being used during 1936 nearer the limit of their rated capacity than at any previous time in the history of the industry. Utilization factor (ratio of peak to capacity) rose in pronounced manner. On the average


CHANGE IN UTILIZATION FACTOR 1934-1936
Utilization Factor
CHANGE IN PLANT FACTOR 1934-1936
Plant Factor
Hydro standby
Thousands of Kw.
RELATION BETWEEN STATION INVESTMENT AND UTILIZATION FACTOR
Station Investment, Dollars Per Kw.
Utilization Factor
RELATION OF STATION INVESTMENT (EX SUBSTATION) AND THERMAL EFFICIENCY TO FUEL COST
Investment
Thermal efficiency
Thermal Efficiency, Per Cent
Fuel Cost - Cents Per Million B.T.U.
RELATION BETWEEN STATION INVESTMENT AND PLANT FACTOR
Plant Factor



the reporting plants show a utilization of 105.5 per cent, which is nearly 10 per cent higher than the 96 per cent figure of the 1935 list of stations. Evidently confidence in the reliability of steam station equipment has been justifiably used as a support for more assignment of load during peak hours. More judicious scheduling of overhauls has manifestly made practically all of the equipment available for carrying the seasonal peaks.

Meanwhile there has been only a slight improvement in plant factor (average load to capacity) in two years, namely, from 53.2 to 55.4 per cent for these sample groups of stations. The mistake must not be made of taking either the utilization or plant factors of individual stations as indicative of the system figures because loads at peaks and at other times can be shifted to the most advantageous sources. Nevertheless it is fairly evident that these changes in utilization and plant factors are coupled with a load factor (ratio of average to peak) that has shrunk from a 55.2 per cent average value in 1934 to 51.9 per cent in 1936. In so far as individual stations reflect system conditions, it appears that acceleration of load building does not always result in a bettered load curve. In any event the performance of these stations at higher levels of peak and output points to the feasibility of purchasing equipment which has its point of maximum efficiency nearer to rated capacity than has prevailed under less sustained loading. At least many stations were undoubtedly not designed for the high utilization and plant factors under which they operated in 1936.

In connection with the analysis of fixed charges it should be emphasized that certain of the stations have included preparations for future capacity which is not yet in operation. This is, however, a situation that is always likely to be encountered. For the stations added to this year's list the average cost per kilowatt is about $5 less than those reported in both 1935 and 1937 listings. In so far as these involve new capacity added during the last two years they reflect a downward trend of cost per kilowatt, attributable in part to the prevailing practice of the industry in superposing units and modernizing existing station and facilities.

Station size affects energy cost

Analysis of production costs show that maintenance expenditures have not been increased, but that fuel, wages, supervision, water, lubricants and supplies have increased on the average for all stations.

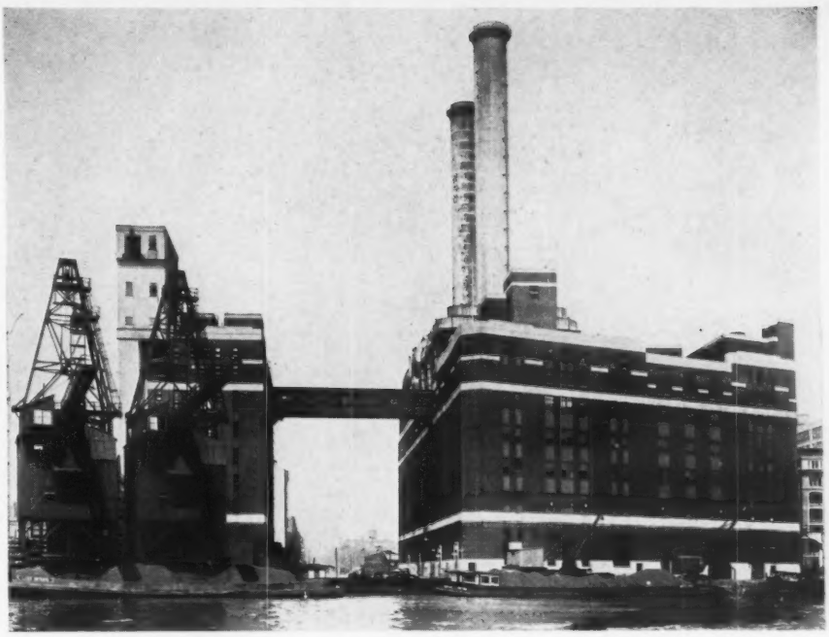
With one notable exception, the high-pressure plants still do not show any over-all economic superiority over the medium-pressure stations. For these particular 21 stations the high-pressure plants show to better advantage than did the same stations two years ago only when efficacy is measured in terms of B.t.u. per kilowatt-hour generated rather than in B.t.u. per net kilowatt-hour sent out. The more favorable plant factor is to be credited with most of this gain.

Now that stations are more favorably loaded, it is possible to discern that the larger stations are generating a kilowatt-hour at a lower total of fixed and operating charges than the middle-sized stations. But it is quite possible for still smaller stations to outdo the larger in over-all cost per kilowatt-hour at the bus under local operating conditions. When, however, stations are placed on a comparable basis of plant and utilization factors (as has been done in one of the charts herewith), it appears that the larger the station the less the cost of a kilowatt-hour at the bus. The spread is of the order of 6 to 8 mills under these assumed comparable conditions for sta-

tions not over 300,000 kw. Too much emphasis cannot be placed on this conclusion, however, because stations have to operate on actual loadings and not hypothetical loadings assumed just to render them comparable.

Cost of power under comparable conditions

Inasmuch as the prevailing utilization factors are on the average well above 90 per cent, it was felt that the comparison of the stations at that particular value of performance would be more significant of the current trend than the 75 per cent value used heretofore. New values of fixed charges were determined by assuming an investment figure matching a proportional increase or decrease of capacity to bring the utilization factor



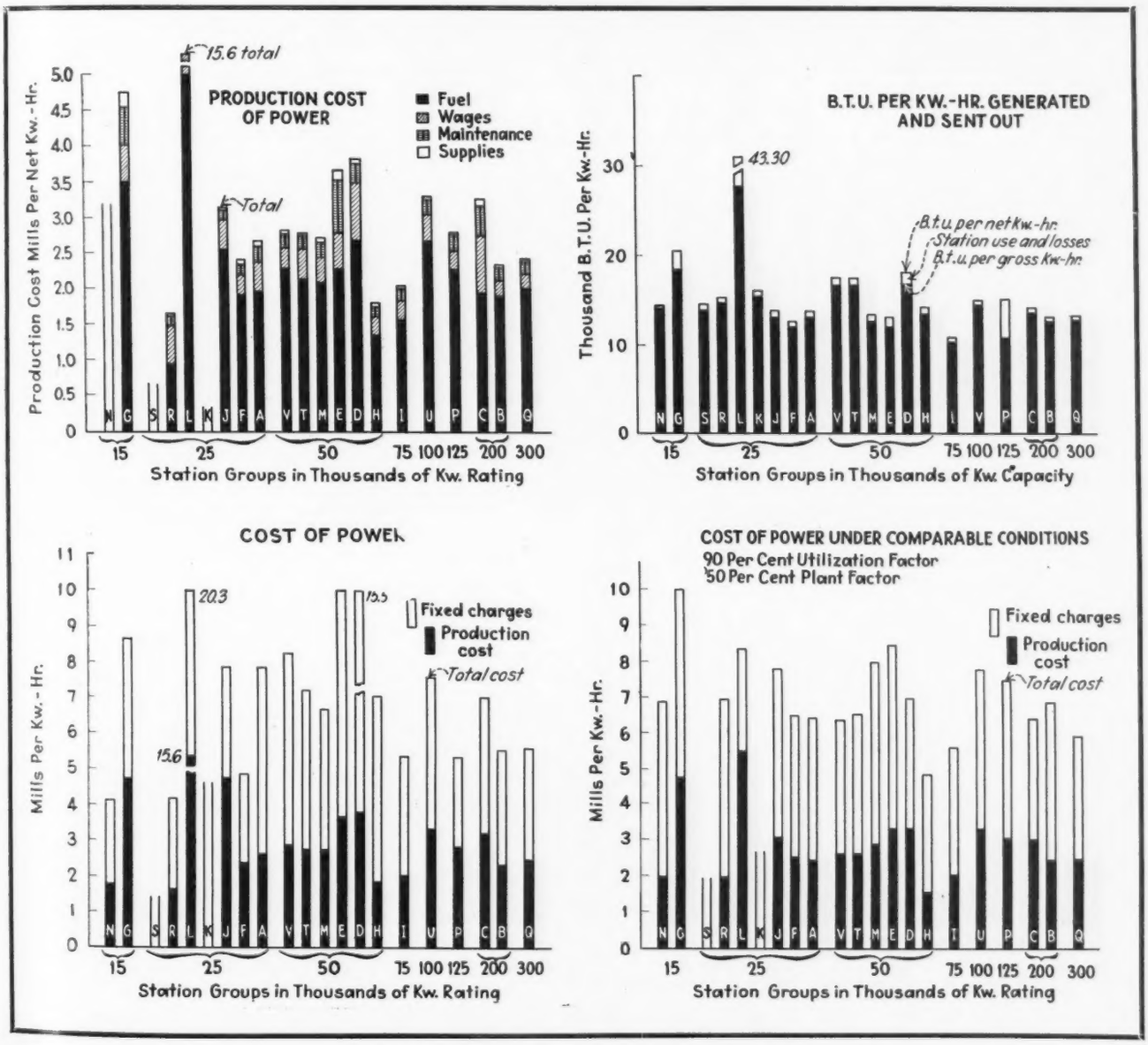


Table I—Equipment, Fuel Data and

STATION	A	B	C	D	E	F	G	H	I	J
Approximate rating, kw	25,000+	200,000+	200,000—	50,000+	50,000+	25,000+	15,000—	50,000+	75,000+	25,000+
Number of generators	2	1	4	2	2	1	2	1	1	1
Number of boiler units	2	6	5	3	3	2	2	2	1	2
Type of service	Trans.	Base	Distrib.	Trans.	Base	Base	Pwr.-St'm	Standby	Base	Trans.
Number of outgoing lines	4	10	42	6	12	13	9	2	6	5
Approx. kv. of lines	6.6–66	33–66–132	24	66	26–33–66	13.2–33	4	44–110	26.4–132	12.5–132
Fuels used in plant	Coal	Coal-Gas	Coal-Oil	Gas	Coal	Coal	Coal-Gas-Oil	Coal	Coal	Coal
Steam pressure, boiler, lb	525	800	405	427 abs.	1,400	665 abs.	600	475	1,390	650
Steam temperature, boiler, F	825	730	700	717	750	825	725	725	835	825
Plant structure area, acres	0.38	3.35	2.50	0.42	5.7	0.83	0.27	0.54	0.85	0.92
Fuel storage area, acres	0.75	7.2	7.65	3 Tanks	1.6	1.24	0.9	.....	7.66	15
Size of boiler units	200,000 lb./hr.	450,000 lb./hr.	340,000 lb./hr.	250,000—300,000 lb.	279,000 lb./hr.	375,000 lb./hr.	150,000 lb./hr.	400,000 lb./hr.	690,000 lb./hr.	400,000 lb./hr.
Average cooling water temp., F	60	53.5	50	75.3	55	63	71.7	81	46.7	47
Average vacuum on condensers	28.90 Hg.	0.452 lb.	28.68 Hg.	1.21 in.	28.98 Hg.	1.26 in.	26.5 Hg.	28 Hg.	0.56 in.	1.04 in.
Number in operating force shift	7	67	42	7	10	6 –11	5	18	15	6
Equipment Used:										
Air preheating	√	√	√	√	√	√	√	√	√	√
Steam reheating	.....	√	.....	.....	√	.....	.....	.....	√	.....
Economizers	√	√	√	.....	√	√	√	.....	.....	√
Waterwall furnaces	√	√	√	√	√	√	√	.....	√	√
Stokers	.....	.....	√	.....	.....	.....	.....	.....	.....	.....
Stage bleeding	√	√	√	√	√	√	√	√	√	√
Duplicate feed pumps	√	√	√	√	√	√	√	√	√	√
Generator air coolers	√	√	√	√	√	√	√	√	√	√
Automatic combustion	.....	√	.....	.....	.....	√	.....	√	√	.....
Outdoor switchyard	√	√	√	√	√	.....	√	√	√	√
Pulverized fuel	√	√	.....	.....	√	√	√	√	√	√
Fuel Data for 1936:										
Total fuel used:										
Short tons of coal	48,990	394,343	311,233	.....	86,653	110,508	10,448	93,770	159,643	67,891
1,000 cu. ft. of gas	.....	7,998,211	.....	1,349,426	.....	.....	1,455,594	.....	.....	.....
Barrels of oil	363	.....	2,424	.....	2,145	.....	618	.....	.....	.....
Ash content of coal, per cent	3.78	12.97	7.10	.....	9.15	6.79	16	13.0	8.92	4.01
Moisture content, per cent	3.93	13.67	4.04	.....	3.61	2.59	7	6.0	4.30	5.3
Fuel Cost Delivered, Dollars:										
Per short ton of coal	4.02	3.33	3.68	.....	4.49	4.27	3.16	2.39	3.83	.....
Per 1,000 cu. ft. of gas	.....	0.125 mil.B.t.u.	.....	0.159	.....	.....	0.15	.....	.....	.....
Per bbl. of oil	2.27	.....	2.13	.....	2.01	.....	1.47	.....	.....	.....
Heat Value of Fuel as Fired:										
Coal, B.t.u. per lb	14,273	10,331	13,570	.....	13,573	14,219	10,580	12,220	13,135	13,385
Gas, per cu.-ft.	.....	1,042	.....	1,085	.....	.....	1,022	.....	.....	.....
Operating Costs, 1936 (mills per net kw.-hr.):										
Fuel	1.96	1.884	1.914	2.71	2.28	1.898	3.51	1.36	1.598	2.544
Wages and superintendence	0.41	0.234	0.789	0.79	0.52	0.297	0.52	0.28	0.266	0.402
Water, lubrication and supplies	0.07	0.026	0.113	0.05	0.13	0.051	0.21	0.02	0.036	0.024
Maintenance and repairs, total	0.24	0.187	0.408	0.26	0.74	0.139	0.52	0.15	0.155	0.134
Buildings and structures	0.03	0.022	0.086	0.05	0.06	0.011	0.09	.....	0.009	0.009
Boiler plant	0.16	0.113	0.202	0.12	0.15	0.090	0.25	.....	0.115	0.042
Fuel-handling equipment	.....	0.004	0.026	0	0.27	0.022	.....	.....	.....	.....
Prime movers and auxiliaries	0.035	0.028	0.063	0.05	0.18	0.009	0.13	.....	0.031	0.072
Electrical equipment and miscellaneous	0.015	0.020	0.031	0.04	0.08	0.007	0.05	.....	.....	0.012
Total operating and maintenance, ex fuel	0.72	0.447	1.310	1.10	1.39	0.487	1.25	0.45	0.457	0.560
Total production cost (no fixed charges)	2.68	2.331	3.224	3.81	3.67	2.385	4.76	1.81	2.055	3.104
Total gross generation, millions kw.-hr	106.90	1,317.65	624.04	86.20	199.51	263.23	81.10	172.54	404.17	140.00
Total net generation, millions kw.-hr	100.76	1,254.11	599.77	81.96	181.06	249.40	71.85	164.29	382.86	131.27
Max. load, kw. 30-min. peak	32,000	200,500	145,000	30,500	49,000	38,000	15,000	66,000 (60 min.)	82,000	29,250

Station function classification: A, normal transmission; B, normal base load; C, normal system; D, normal system; E, normal base load; F, normal base load; G, power and district steam; H, standby for hydro; I, normal base load; J, normal transmis-

with the actual peak from its actual value to 90 per cent.

Likewise a plant factor of 50 per cent has been assumed. Along with this assumption is the further assumption that fuel cost per kilowatt-hour remains unchanged and the operating charges for other than fuel remain unchanged in the total of station expenditures for the year. The 50 per cent factor pertains not to the actual capacity but to the capacity which would create a 90 per cent utilization factor under the actual peak and annual ouput of the station.

Total cost of energy, including fixed charges, ranges upward from 4.14 mills per kilowatt-hour. Omitting the standby stations, there are several operating with combined fixed and operating charges in the range from 6½ to 9 mills; the actual spread is thus greater because of the greater spread in utilization and plant factors.

Fuel costs of production per kilowatt-hour for these stations ranges from 2 to 2.5 mills, except for one which generates at 1 mill, using coke at $1.91 per ton. Fuel costs as purchased gave a spread from 10 to 19 cents per million B.t.u. The coke-burning plant has a fuel cost of less than 6.5 cents per million B.t.u. Even where total costs are the highest the wage and maintenance items do not total to more than 1 mill on the average. Wherever the over-all cost is high it is traceable directly to high fixed charges resulting from high investment. In general, the fixed charges represent never less than half the total cost of energy at the bus. Roughly, if energy costs as much as 9 mills it is because fuel costs about 3 mills, fixed charges amount to 5.6 mills, with the

Production Costs For Steam Stations in 1936

K	L	M	N	P	Q	R	S	T	U	V	STATION
25,000+	25,000+	50,000+	25,000—	125,000—	300,000	25,000—	25,000—	50,000—	100,000—	50,000+	Approximate rating, kw.
1	1	2	1	3	3	1	1	2	4	2	Number of generators.
3	2	3	3	4	14	2	1	4	6	4	Number of boiler units.
Distrib.	Standby	Trans.	Trans.	Pwr-Stm	Base	Base	Distrib.	Base	Base	Trans.	Type of service.
2	6	4	4	10	31	4	5	8	20	7	Number of outgoing lines.
11	12	132	66	33–66	13.2	66	14	13.2–66	11	33–66	Approximate kv. of lines.
Coal	Gas-Oil	Coal	Gas	Coal	Coal	Coke	Coal	Coal-Gas	Coal-Oil	Oil-Gas	Fuels used in plant.
41	450	700	400	1,350	400	400	450	440	.....	400	Steam pressure, boiler, lb.
72	646	775	698	725	850	720	775	740	.....	700	Steam temperature, boiler, F.
0	0.64	1.6	0.34	70	3.6	0.20	0.35	2	Inc. below	0.55	Plant structure area, acres
1	.....	20	.....	.....	10	3.50	0.15	5	55	.....	Fuel storage area, acres.
140,000–	350,000	345,000	10,012	9,000	200,000—	150,000	325,000	140,000	.....	200,000	Size of boiler units.
230,000 l	lb./hr.	lb./hr.	sq. ft.	sq. ft.	600,000 lb.	lb./hr.	lb./hr.	lb./hr.		lb./hr.	
6	60	51.6	61	58	59.8	62	49	57.5	50	72	Average cooling water temperature, F
2.24 in.	28.5 Hg.	1.09 in.	28.53 Hg.	1.24 in.	28.68 Hg.	1.70 in.	1.29 in.	1.28, 1.19	1.4 in.	28.40 Hg.	Average vacuum on condensers.
1	7	8–14	3	.....	39	5	46 total	7	.....	7	Number in operating force shift.
											Equipment Used:
.....	.....	√	√	√	√	√	.....	√	.....	√	Air preheating.
.....	.....	.....	.....	√	.....	.....	.....	.....	.....	.....	Steam reheating.
√	.....	√	.....	√	√	.....	.....	√	.....	.....	Economizers.
√	√	√	.....	√	√	√	√	√	.....	√	Waterwall furnaces.
√	.....	.....	.....	.....	√	.....	.....	.....	√	.....	Stokers.
√	√	√	√	√	√	√	√	√	.....	√	Stage bleeding.
√	√	√	√	√	√	√	√	√	.....	√	Duplicate feed pumps.
√	√	√	√	√	√	√	√	√	.....	√	Generator air coolers.
√	√	.....	.....	√	√	.....	.....	.....	.....	√	Automatic combustion.
.....	√	√	.....	√	√	√	.....	√	.....	√	Outdoor switchyard.
.....	.....	√	.....	√	√	√	√	√	√	.....	Pulverized fuel.
											Fuel Data for 1936:
114,808	.....	222,385	.....	499,831	657,983	64,455	42,624	51,482	70,688	.....	Total fuel used:
.....	283,935	471	1,847,878	.....	.....	.....	.....	1,523,340	.....	2,881,581	Short tons of coal.
.....	11,340	.....	2,435	.....	.....	.....	.....	.....	667,961	.....	1,000 cu.ft. of gas.
5.38	.....	11.07	.....	5.4	6.61	0.08	5	10.77	3.75	.....	Barrels of oil.
2.73	.....	13.31	.....	4.8	3.09	5.7	5	12.41	4.0	.....	Ash content of coal, per cent
											Moisture content, per cent
											Fuel Cost Delivered, Dollars:
4.16	.....	3.46	.....	4.13	4.36	1.914	4.64	2.74	5.23	.....	Per short ton of coal.
.....	0.128	.....	0.093	.....	.....	.....	.....	.....	.....	0.138	Per 1,000 cu.ft. of gas.
.....	0.98	.....	1.04	.....	.....	.....	.....	.....	1.13	.....	Per bbl. of oil.
											Heat Value of Fuel as Fired:
14,269	18,500	10,496	Oil 18,500	13,927	14,108	14,987	13,792	10,672	14,280	.....	Coal, B.t.u. per lb.
.....	1,200	.....	1,051	.....	.....	.....	.....	1,041	153 Oil M gal.	1,050	Gas, per cu. ft.
											Operating Costs, 1936 (mills per net kw.hr.):
Not segregated, an extension	5.00	2.106	1.285	2.29	2.090	0.96	Not re-	2.13	2.694	2.31	Fuel.
	7.60	0.351	0.215	0.261	0.198	0.52	ported.	0.42	0.377	0.33	Wages and superintendence.
	In above	0.085	0.052	0.035	0.023	0.02	.....	0.01	0.053	0.06	Water, lubrication and supplies.
	3.00	0.198	0.222	0.240	0.157	0.15	.....	0.19	0.212	0.18	Maintenance and repairs, total.
	.....	0.023	0.017	0.017	0.037	0.02	.....	0.01	0.023	0.05	Buildings and structures.
	.....	0.148	0.116	0.127	0.076	0.08	.....	0.12	0.128	0.06	Boiler plant.
	.....	0.005	In boiler	.....	0.007	0.03	.....	In fuel	0.010	.....	Fuel-handling equipment.
	.....	0.018	0.056	0.024	0.026	0.01	.....	0.03	0.028	0.04	Prime movers and auxiliaries.
	.....	0.004	0.033	0.072	0.011	0.01	.....	0.03	0.023	0.03	Electric equipment and miscellaneous.
	10.6	0.634	0.489	0.537	0.378	0.69	.....	0.62	0.642	0.57	Total operating and maintenance, ex fuel.
	15.6	2.740	1.774	2.83	2.468	1.65	.....	2.75	3.336	2.88	Total production cost (no fixed charges).
	14.45	388.03	138.47	989.99	1,458.99	131.59	85.20	160.91	430.06	182.94	Total gross generation, millions kw.-hr
	9.26	365.98	134.95	919.08	1,391.00	127.81	81.53	153.02	417.28	172.57	Total net generation, millions kw.-hr.
	40,000	66,000	19,900	130,000	266,000	18,144	28,000	36,000	88,000	59,160	Maximum load, kw. 30-min. peak.

sion; K, normal distribution and transmission; L, standby for hydro; M, normal transmission; N, normal transmission; P, power and process steam for which credit is not given in the data; Q, normal system, base load; R, normal base load; S, normal system; T, normal base load; U, normal base load; V, normal transmission.

rest accounted for by wages, maintenance and supplies.

In these representative stations the total cost of energy in 1936 ranged from 4.14 to 20.27 mills per kilowatt-hour, the high figure being for a station that was operated solely as a standby for hydro generation. The average is about 7.5 mills per kilowatt-hour. The fixed charges (at 15 per cent) range from 2.37 mills to 11.7 mills, with an average of 4.5 mills. The production cost ranges from 1.65 mills to 15.6 mills (again for the hydro standby plant) per kilowatt-hour sent out, with an average of about 3 mills. Thus about 60 per cent of the total cost of energy originates in the fixed charges and 40 per cent in the production costs. Fuel alone represents an average of 70 per cent of the total production, but only 30 per cent of the average total energy cost for these typical plants.

On the whole, the design of these particular stations appears rational in the sense that more money has been spent to attain high thermal efficiencies in instances where the fuel cost in cents per million B.t.u. happens to be high. There is correlation between investment and plant factor, but hardly any discernible relation between the investment and the utilization factor. This is probably as it should be considering that utilization factor has a meaning for only the peak half-hour, whereas the plant factor is the index of a situation extending over the year. The higher the plant factor the more money appears justifiably to have been spent to create an efficient kilo-

Table II—Unit Investment Cost, Total

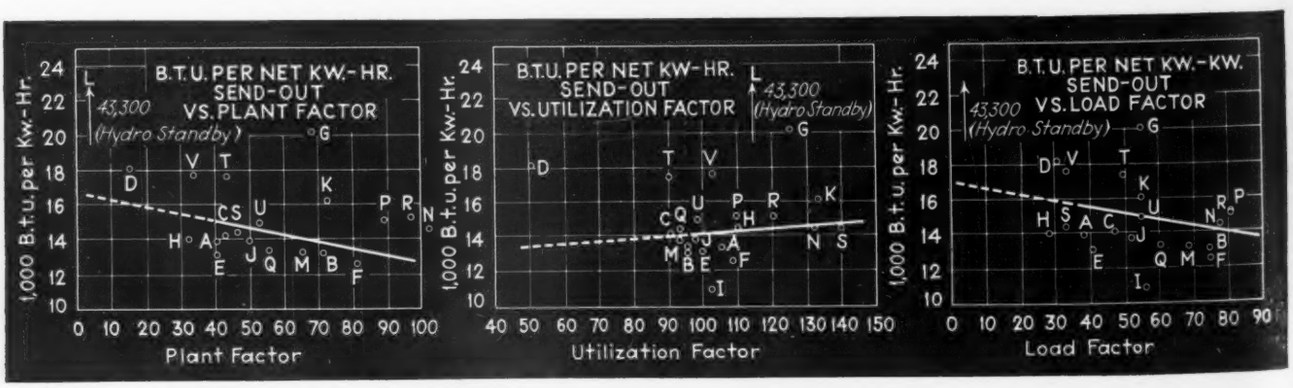
STATION	A	B	C	D	E	F	G	H	I	J
Unit Investment Cost, Dollars per Kw.:										
Land, cost and site preparation	1.42	6.27	5.64	7.87	1.01	10.89	2.33	0.72	5.24	2.84
Buildings and foundations	21.25	26.90	24.82	28.08	.....	27.20	22.74	24.85	21.30	27.50
Condensing water supply and works	4.45	3.93	1.79	Incl.	.....	4.80	8.71	8.07	1.83	6.66
Fuel unloading, handling, storage	2.47	6.80	6.24	in	.....	3.21	4.77	3.94	15.50	6.66
Ash handling	0.90	1.66	.....	other	.....	1.68	4.22	0.30	0.75	0.83
Fuel preparation	2.95	3.17	4.18	items	.....	2.35	3.92	2.09	3.44	3.33
Switchgear and station wiring	9.12	17.56	2.22	5.38	.....	17.75	15.50	8.67	8.05	19.70
Boiler plant	19.25	19.40	12.50	28.20	.....	16.75	31.06	13.50	13.22	23.00
Draft system	3.98	3.39	2.46	Incl.	.....	9.22	4.38	4.08	1.48	2.84
Feedwater system	3.73	1.43	1.12	in	.....	3.91	3.69	1.66	3.00	4.33
Piping system	7.50	7.05	7.28	other	.....	7.97	15.20	4.38	3.01	5.33
Turbine foundations	1.09	0.20	1.32	items	.....	.....	1.07	0.58	0.92	0.83
Heat recovery apparatus	.....	.....	2.12	4.85	.....	.....	4.83	.....	1.79	1.33
Generator air coolers	.....	0.39	0.26	.....	.....	0.26	0.63	0.79	0.24	0.17
Main condensers	4.35	2.68	3.40	.....	.....	1.57	5.38	3.24	2.69	3.33
Turbo-generators	18.85	14.43	14.05	21.16	.....	15.97	20.31	12.40	17.20	18.35
Turbine auxiliaries	0.65	0.34	3.36	.....	.....	0.27	6.57	0.34	0.52	2.10
Outdoor switchyard	13.35	7.95	1.22	10.60	13.40	6.66	0	5.76	5 69	10.00
Total station, including miscellaneous	101.96	121.15	92.76	95.97	139.10	124.84	155.31	89.61	100.18	129.14
Total station and switchyard	115.31	129.10	93.98	106.57	152.50	131.50	155.31	95.37	105.87	139.14
Cost of Energy, Mills per Net Kw.-hr.										
Fixed charges at 15 per cent	5.17	3.22	3.80	11.70	6.34	2.45	3.90	5.23	3.31	4.77
Production charges	2.68	2.33	3.22	3.81	3.67	2.39	4.76	1.81	2.06	3.10
Total cost of energy per kw.-hr	7.85	5.55	7.02	15.51	10.01	4.84	8.66	7.04	5.37	7.87
Fixed charges at 90 utilization factor	3.98	4.43	3.38	3.65	5.15	3.95	5.29	3.30	3.62	4.76
Production charges at 50 plant factor	2.44	2.45	3.02	3.32	3.32	2.55	4.72	1.56	2.04	3.06
Total equivalent cost of energy	6.42	6.88	6.40	6.97	8.47	6.50	10.01	4.86	5.66	7.82
Station Performance in 1936:										
Millions B.t.u. used	1,400,000	16,450,000	8,479,000	1,490,000	2,365,000	3,140,000	1,490,000	2,300,000	4,200,000	1,817,000
Fuel cost, cents per million B.t.u.	14.1	14.30	13.60	15.00	17.50	15.00	16.90	9.80	14.60	18.40
B.t.u. per net kw.-hr. send-out	13,899	13,143	14,120	18,140	13,066	12,598	20,700	14,000	10,954	13,846
B.t.u. per gross kw.-hr. generated	13,080	12,500	13,600	16,900	11,900	11,930	18,350	13,300	10,380	12,950
Average boiler efficiency, per cent	86.13	83 70	83.50	80.0	83.0	84.6	82.0	85.0	86.0	86.8
Thermal efficiency, net basis	24.6	26.0	24.2	18.8	26.2	27.1	16.5	24.4	31.1	24.6
Employees per 1,000 kw. per day	0.70	0.98	1.79	0.35	0.60	0.66	1.25	0.9	0.56	0.60
Plant factor, annual, per cent	40.9	71.39	42.7	15.6	40.1	81.3	68.4	31.3	57.6	50.0
Utilization factor, annual, per cent	106.6	96.5	90.7	50.8	98.0	108.6	125.0	110.0	102.5	97.5
Station Unit Space Factors:										
Boiler room, cu.ft. per kw	21.30	20.90	17.40	6.15	16.04	44.40	40.80	18.15	18.10	29.90
Turbine room, cu.ft. per kw	14.10	12.90	15.00	13.80	6.24	27.70	29.00	12.00	8.94	23.30
Switchhouse, cu.ft. per kw	.....	2.02	9.37	0.20	3.08	15.60	8.35	1.24	6.45	1.48
Fuel preparation room, cu. ft. per kw	4.47	.....	3.74	5.04	1.62	0	In boiler	6.57	In boiler	0.38
Station site, sq. ft. per kw	0.55	0.70	0.68	0.31	5.00	1.03	0.98	0.39	0.46	1.33
Storage site, sq. ft. per kw	1.09	1.51	2.08	.....	1.40	1.55	3.28	.....	4.17	.....
Switchyard, sq. ft. per kw	2.24	2.82	.....	1.02	3.08	.....	0.94	0.41	0.52	0.54
Storage capacity, tons per kw	0.27	0.58	0.85	.....	0.44	0.57	0.13	2.50	0.41	0.08

Includes expenditures for uncompleted addition

watt of capacity. Again, it may be said that the prevailing plant factors could well have been the basis at which the designs have been aimed, but it is doubtful if the high utilization factor were equally anticipated. Note that one plant operated during 1936 with a 140 per cent utilization factor; another, more startlingly significant, operated with a plant factor of 102.5 per cent.

Commentary on the design of these stations would not be complete, however, without mention of the surprisingly small range of B.t.u. per net kilowatt-hour over the whole spread of fuel cost from 6 to 19 cents per million B.t.u. Correlation between B.t.u. per net kilowatt-hour sent out and the fixed charges seems to be wholly lacking. It would seem that, granting fairly uniform fuel costs, this would be the most prominent relationship to be discovered in any study of investment balanced against production efficiency and economy. To this extent the experience with typical existing stations is a poor guide to the designer of comparable future stations.

As is to be expected, the B.t.u. per net kilowatt-hour reflects a downward trend with the rising plant factor. The same unit index decreases with the


B.T.U. PER NET KW.-HR. SEND-OUT VS. PLANT FACTOR
43,300 (Hydro Standby)
1,000 B.t.u. per Kw.-Hr.
Plant Factor
B.T.U. PER NET KW-HR. SEND-OUT VS. UTILIZATION FACTOR
43,300 (Hydro Standby)
Utilization Factor
B.T.U. PER NET KW.-KW. SEND-OUT VS. LOAD FACTOR
43,300 (Hydro Standby)
Load Factor

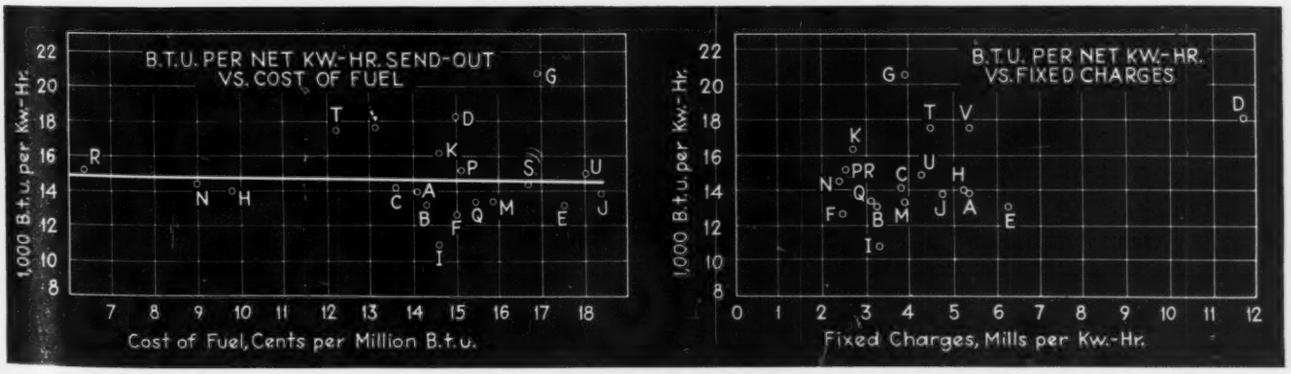
Power Cost and Performance of Steam Stations in 1936

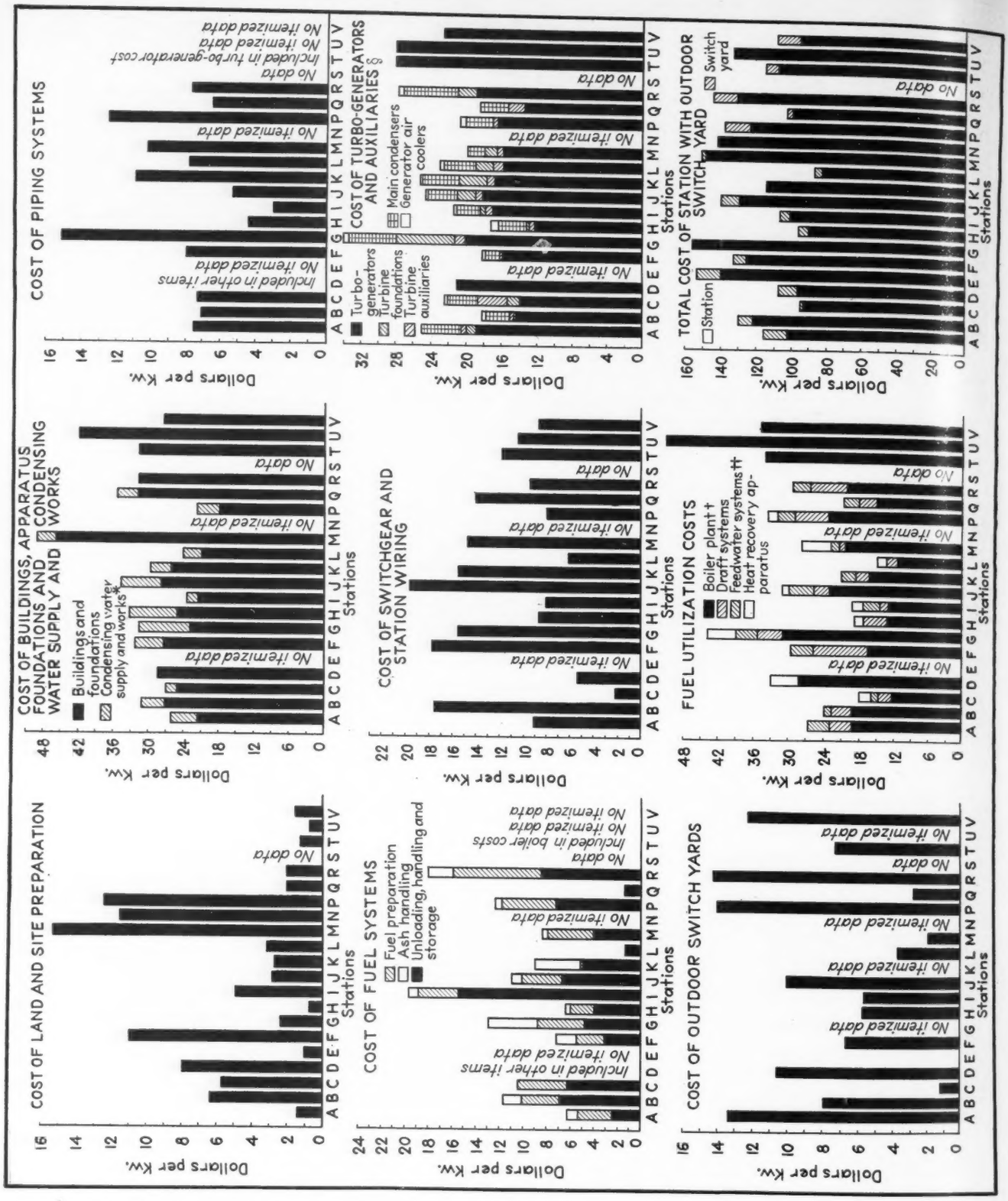
K	L	M	N	P	Q	R	S	T	U	V	STATION
											Unit Investment Cost, Dollars per Kw.
2.74	3.07	15.62	11.40	12.38	1.99	1.99	.....	1.18	0.73	1.53	Land, cost and site preparation.
25.92	20.65	45.50	.....	17.80	31.60	31.60	.....	31.38	41.40	27.25	Buildings and foundations.
3.47	3.13	3.11	.....	3.50	3.47	In bldg.	.....	In bldg.	.....	In bldg.	Condensing water supply and works.
4.93	1.82	3.99	.....	7.20	1.40	8.43	.....	In blr.	.....	.....	Fuel unloading, handling, storage.
3.98	.....	0.44	.....	0.56	.....	2.22	.....	In blr.	.....	.....	Ash handling.
0.11	.....	3.97	.....	4.63	.....	7.44	.....	In blr.	.....	.....	Fuel preparation.
15.60	6.14	14.78	.....	7.97	14.01	9.43	.....	11.82	10.49	8.69	Switchgear and station wiring.
16.43	1.49	20.30	.....	23.20	15.15	20.20	.....	33.88	50.80	34.45	Boiler plant.
2.30	2.06	1.10	.....	5.91	3.05	6.12	.....	In blr.	.....	.....	Draft system.
2.51	1.72	1.56	.....	2.95	2.51	3.11	.....	In turb.	.....	.....	Feedwater system.
10.77	7.80	10.17	.....	12.50	6.51	7.67	.....	In turb.	.....	.....	Piping system.
1.04	1.22	0.59	.....	0.61	1.87	In bldg.	.....	In bldg.	.....	.....	Turbine foundations.
0	.....	4.93	.....	1.66	.....	In boiler	.....	In blr.	.....	.....	Heat recovery apparatus.
0.13	0.25	.....	.....	0.55	.....	0.52	.....	In turb.	.....	.....	Generator air coolers.
4.11	3.62	1.92	.....	3.13	3.19	6.06	.....	In turb.	.....	.....	Main condensers.
16.85	15.88	16.02	.....	16.60	13.60	19.10	.....	28.35	28.30	22.90	Turbo-generators.
3.10	1.99	1.44	.....	.....	.....	2.18	.....	In turb.	.....	.....	Turbine auxiliaries.
0	3.70	1.96	.....	14.00	2.81	14.22	.....	7.30	.....	12.28	Outdoor switchyard.
113.99	82.42	147.64	141.77	122.50	98.79	129.90	.....	106.61	131.72	95.14	Total station, including miscellaneous.
113.99	86.12	149.60	.....	136.50	101.60	144.12	.....	113.91	.....	107.42	Total station and switchyard.
											Cost of Energy, Mills per Net Kw.-hr.
2.65	4.67	3.93	2.37	2.50	3.12	2.55	.....	4.45	4.27	5.36	Fixed charges at 15 per cent.
.....	15.60	2.74	1.77	2.83	2.47	1.65	.....	2.75	3.34	2.88	Production charges.
.....	20.27	6.67	4.14	5.33	5.59	4.20	.....	7.20	7.61	8.24	Total cost of energy per kw.-hr.
4.10	2.83	5.12	4.84	4.42	3.44	4.94	.....	3.88	4.50	3.72	Fixed charges at 90 utilization factor.
.....	5.51	2.89	1.97	3.07	2.49	1.96	.....	2.67	3.32	2.66	Production charges at 50 plant factor.
.....	8.34	8.01	6.81	7.49	5.93	6.90	.....	6.55	7.82	6.38	Total equivalent cost of energy.
											Station Performance in 1936:
1,275,000	402,000	4,870,000	1,951,000	13,927,000	18,580,000	1,931,000	1,176,000	2,675,000	6,240,000	3,030,000	Millions B.t.u. used.
14.60	11.60	15.85	8.94	15.1	15.43	6.39	16.62	12.20	18.01	13.10	Fuel cost, cents per million B.t.u.
16,110	43,300	13,303	14,497	15,180	13,342	15,117	14,421	17,459	14,976	17,625	B.t.u. per net kw.-hr. send-out.
15,480	27,800	12,520	14,100	10,920	12,720	14,680	13,810	16,600	14,500	16,630	B.t.u. per gross kw.-hr. generated.
80.8	.....	86.5	82.7	87.0	83.3	85.3	79.5	83.4	.....	80.0	Average boiler efficiency, per cent.
21.2	7.87	25.6	23.6	22.5	25.6	22.6	24.7	19.53	22.80	19.35	Thermal efficiency, net basis.
.....	0.60	0.47	0.60	1.62	0.41	1.00	2.30	0.53	.....	0.38	Employees per 1,000 kw. per day.
73.1	3.0	65.3	102.5	88.5	55.9	97.0	46.6	43.7	53.0	34.3	Plant factor, annual, per cent.
133.7	114.0	95.5	132.5	109.5	93.3	120.8	140.0	90.0	97.6	103.0	Utilization factor, annual, per cent.
											Station Unit Space Factors:
25.80	31.7	31.2	21.8	22.40	27.25	28.20	23.10	28.20	.....	13.13	Boiler room, cu. ft. per kw.
12.65	19.0	26.9	11.1	17.90	23.25	14.07	29.85	32.00	.....	9.53	Turbine room, cu. ft. per kw.
6.50	2.37	0.30	1.89	2.59	7.98	.....	7.10	7.55	.....	.....	Switchhouse, cu.ft. per kw.
8.16	.....	.....	.....	4.80	1.13	.....	0.89	1.03	.....	.....	Fuel preparation room, cu.ft. per kw.
0.29	0.80	1.09	0.99	0.63	0.51	0.58	0.76	2.18	.....	0.42	Station site, sq.ft. per kw.
2.18	.....	13.59	.....	.....	1.51	1.02	0.33	5.44	.....	.....	Storage site, sq.ft. per kw.
.....	0.18	1.77	.....	2.69	0.21	5.62	.....	0.38	.....	0.78	Switchyard, sq.ft. per kw.
0.70	1.07 bbl.	0.63	.....	0.84	0.21	3.00	0.10	.....	0.56	.....	Storage capacity, tons per kw.

rising load factor, but at a lessened rate of decrease. As a consequence the B.t.u. per net kilowatt-hour shows a rising characteristic for stations operating at the higher utilization factors. This is in keeping with reason. It is especially true for those stations loaded at peak considerably beyond rated capacity, presumably because the loading during 1936 was for a large part of the time above the point of maximum efficiency of the aggregate of generating facilities.

Although no increase in capacity is recorded for several of the plants, nevertheless the owners report different values than in 1935 for the component costs of the plants. Modernization of the constituent facilities accounts for certain of these changes in details and the transition to new uniform systems of accounting account for the rest of the changes. The charts grouped herewith serve to show how designers allocated their outlays to constituent parts of the stations built largely during the last decade.

Pulverized fuel is used in 72 per cent of the plant capacity in which coal is the dominant fuel, the rest (28 per cent) reflecting stoker firing. Water-wall furnaces prevail to the extent of 89 per cent of the capacity


B.T.U. PER NET KW-HR. SEND-OUT VS. COST OF FUEL
1,000 B.t.u. per Kw.-Hr.
Cost of Fuel, Cents per Million B.t.u.
B.T.U. PER NET KW-HR. VS. FIXED CHARGES
1,000 B.t.u. per Kw.-Hr.
Fixed Charges, Mills per Kw.-Hr.


COST OF LAND AND SITE PREPARATION
COST OF FUEL SYSTEMS
Fuel preparation
Ash handling
Unloading, handling and storage
COST OF OUTDOOR SWITCH YARDS
COST OF BUILDINGS, APPARATUS FOUNDATIONS AND WATER SUPPLY AND CONDENSING WORKS
Buildings and foundations
Condensing water supply and works*
COST OF SWITCHGEAR AND STATION WIRING
FUEL UTILIZATION COSTS
Boiler plant††
Draft systems
Feedwater systems††
Heat recovery apparatus
COST OF PIPING SYSTEMS
COST OF TURBO-GENERATORS AND AUXILIARIES§
Turbo-generators
Turbine foundations
Turbine auxiliaries
Main condensers
Generator air coolers
TOTAL COST OF STATION WITH OUTDOOR SWITCH YARD
Station
Switch yard
Dollars per Kw.
Stations
A B C D E F G H I J K L M N P Q R S T U V
No data
No itemized data
Included in other items
Included in boiler costs
Included in turbo-generator cost

in the 21 plants; that is, in all but three of them. Air preheating is the practice in all but four of the plants and it has been applied to 88 per cent of their combined capacity. Economizers represent 71 per cent of the total capacity of 1,495,000 kw. installed in the reported plants; however, the economizer installations appear in only twelve of the 21 plants. Automatic combustion control is reported for 61 per cent of the capacity and the corresponding 909,000 kw. exists in nine of the plants, showing that the larger plants have been more favorable to this feature. Stage bleeding is the practice in all but one of the plants, and that one represents 6 per cent of the aggregate capacity of the 21 typical plants reported.

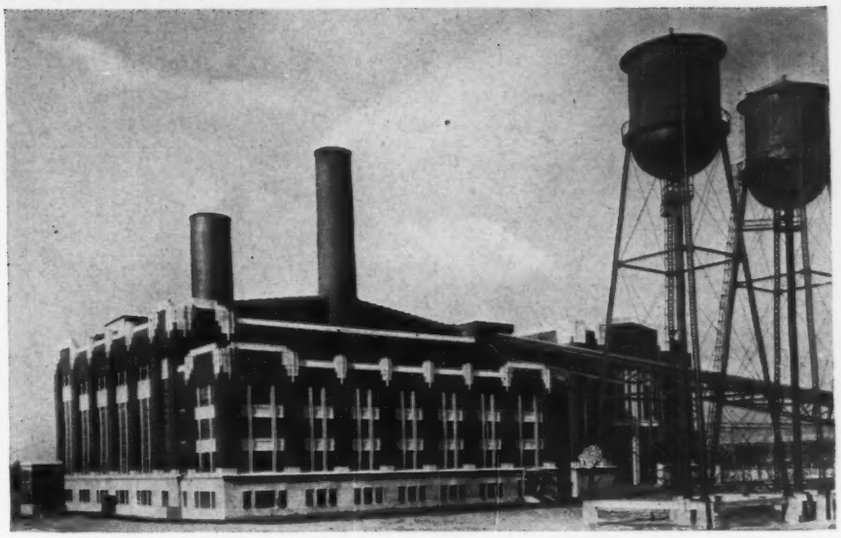
* Included in building cost for R, T, V. Building cost for station D includes other items.

† Includes draft system and heat recovering apparatus for station T; includes other items for station D.

‡ Included in turbine costs for station T.

§ Turbine foundation costs included in building costs for stations R, T; item for station T also includes other items.

By **PHILIP SPORN**
Vice-President and Chief Engineer
American Gas & Electric Company,
New York



2,400 Pounds— a New Power Milestone

Forward Step in Power Generation Economics Maintains Pace Set by Logan, Windsor and Deepwater

BOILER and turbine pressures higher than the top limits of 1,400 lb. prevailing in the present cycle of steam power plant extensions have been employed both in the United States and Europe. In the United States, however, only one case is so far on record.[1] This is an 1,800-lb. industrial installation using high-pressure engines that exhaust into process steam evaporators and does not involve any high-pressure turbines. The European installations[2] have not carried the weight with American engineers they might have, first, because many of them were frankly built to exploit particular or pet ideas chiefly along the lines of forced circulation in the boiler; second, they were in sizes much smaller than are common or have been found economically justifiable in American power plant practice; third, because they were practically all industrial installations, and, finally, because of a belief that in some of the cases cited power generation economics were subjugated to the glory of "carrying the torch," so to speak.

The 67,500-kw., 2,400-lb., 940 deg. F. extension at the Twin Branch plant of the Indiana & Michigan Electric Company will be the first American installation at that pressure and temperature. The size and type of turbine-generator unit, size of boiler, pressures and temperatures, both initial and crossover, and the cycle chosen were all selected because they seemed technically feasible and economically desirable. The installation has, therefore, aroused a considerable technical interest and inquiry. In the light of the long period that of necessity must elapse before the unit will be in operation—it is expected to have the unit on the line in the summer of 1939—it has been thought worth while to give a statement of the underlying bases of the development and a rough sketch of the equipment and arrangement proposed, in so far as these are known at the present time.

Basis of size and type of extension

The Indiana & Michigan Electric Company serves a combined industrial and residential load through the upper half of Indiana and through the southwest section of Michigan. Its present peak load, including the load of the Indiana General Service Company, substantially all of whose generating requirements it furnishes, is approximately 145,000 kw. and it is experiencing a healthy growth. The characteristics of the load curve are predominantly industrial, with a definite industrial morning peak and a secondary afternoon peak. At the present time this load is furnished from the Twin Branch 650-lb. steam plant, which has a capacity of 84,000 kw., from a series of hydro plants on the St. Joseph River, having a peak rating of about 22,000 kw., and by purchase from interconnections, both

[1] "Philip Carey Plant Starts Operation," A. D. Blake, *Power*, May 19, 1931.
[2] "The Benson Boiler," Dr. F. Michel, *Combustion*, July, 1936. "High Spots of German Power Plant Practice," Dr. Ing. Otto Schö[illegible], *Combustion*, October, 1936.

Aims and Significance of Twin Branch

IT WILL be seen from the brief description herewith of the decisions that have been already made on the Twin Branch extension and from a description of what is being attempted that many of the details are still to be developed. That could not be otherwise in view of the total lack of experience and knowledge in this country of the behavior and performance of equipment in the pressure and temperature range attempted. The aim, however, from the very beginning, and this is of great importance, has been very clear; namely, to make a definite and forward step in the economic development of central station power. It was felt that the time for such a step had arrived in view of the large amount of work that was going on at the present time, and the experience that was being gathered in the building of 1,400-lb. plants in temperatures up to 940 deg., both on a superposition basis and direct-condensing cycles. The recent crystallization of thinking, looking toward a reduction in the thickness of boiler tubes, heretofore thought of as the minimum necessary for the higher pressures, was a further factor in the conclusion that the time had arrived for taking advantage of the savings in material thus brought about to improve the general economics of power generation.

Further, it was felt that the large number of 650-lb. plants were gradually approaching the time when modernization would be mandatory, and higher pressures than 1,400 lb. would be the only available solution, but here experience was lacking. On the American Gas & Electric Company system it was fortunate that all this coincided with the period when base capacity was badly needed. The place on the system where this deficiency actually existed—that is, the Indiana & Michigan Electric Company system—was one where the available transmission facilities had practically reached the load-carrying limit and where the fuel cost was higher than existed on any other point. Thus, it became the logical point for taking this advancing step in the economics of power generation.

The design work so far completed and described here, and the work still to be done, it is felt, will definitely promote that end in at least two ways: First, by opening up the path for economical superposition and ultimate rehabilitation of a number of 650-lb. steam stations, among which Twin Branch is one; second, by obtaining a period of temporary stability on the pressure end of power plant development, at any rate, leaving the period of the next decade or two to the development of higher temperatures within the newly established pressure limit of 2,500 lb., as operating experience with present materials and further metallurgical research on new materials becomes available.

Such development as is expected to materialize ought to make, within a comparatively short time, the 10,000 B.t.u.-per-kilowatt-hour, straight-regenerative, steam-cycle plant an economically sound set-up. What there will be beyond that is within the realm of prediction and ought not to give us much concern in the present. In so far as the work that will be carried out at Twin Branch will open the way for further development in high temperatures beyond what is now attempted, there is no question but that the electric utilities, at any rate, will choose to follow up such developments to their utmost economic limits.

* * *

within and outside the company-affiliated groups. The company operates interconnected and is very closely co-ordinated with the system of the Ohio Power Company on the east and with the system of the Northern Indiana Public Service Company (Chicago group) on the west. During the depression it was found possible to take advantage of these interconnections and obtain an appreciable percentage of the entire area supply from outside sources by diversity and incremental trading arrangements. But with the revival of utility system loads following the depression it has been necessary not only to run all the company facilities but to purchase capacity outside of the system. As the load further developed it became practical to consider adding capacity in the form of a reasonable block of new capacity.

Before definitely deciding that, however, the economics of electrical transmission of energy were reconsidered. This problem had been very thoroughly gone into on numerous occasions and, for the Indiana & Michigan system very definitely, some ten years previously; *i.e.*, prior to the installation of the first Twin Branch plant. However, in the light of the fact that considerable progress had been made on the transmission art in the past few years, it was thought best to reconsider the present status of the entire problem. The results of these studies definitely showed that the previously entertained economic limits of transmission had moved out somewhat, but that basically they were of the same order. Thus, at 70 per cent load factor, the utmost distance that power can be transmitted electrically on the same economic basis as coal can be transmitted by freight is still around 100 miles, and this distance decreases as the load factor decreases. In the light of that, the possibility of a major strengthening of the transmission system to permit electrical access to more economical sources of fuel than is available in the immediate territory was definitely rejected, and it was decided to continue to utilize the present transmission system for general integration, co-ordination and emergency protection purposes and for such transmission as can be carried on within its present capacity limits, and to supply the balance of the requirements from local—*i.e.*, territorial—generation.

Superposition thoroughly considered

Having decided that point, several schemes for obtaining the additional capacity at Twin Branch were studied. Particularly was a great deal of study put on the possibility of superposition. Although this seemed to warrant consideration, the idea was eventually turned down for several reasons: First, because of the age of the present plant. The present plant was placed on the line in April, 1925, and thus in terms of 1937, when construction on the new plant is expected to start, it would have had an effective life of twelve years. During that period the depression intervened, and for about four years of that time, as explained above, it was found possible to obtain very economical sources of supply outside the system and within the limits of the existing transmission facilities. This meant less generation at Twin Branch, so that from a wear-and-tear standpoint, the plant as a whole was much younger even than its twelve years of life would indicate. In short, it appeared altogether too young a plant to be superposed. particularly if economical use for the plant in its present condition could be obtained. Besides, the economics of superposition definitely press for a limited number of boiler units and, within the size of the plant considered possible at Twin Branch, for a single high-pressure reducing unit. Keeping in mind the fact that the Twin Branch plant is located at the most expensive fuel point on an interconnected system, having at the present time a peak of 810,000 kw., it appeared definitely unsound to commit such a plant to a layout of that sort, when future

recession in loads might again show the way to economies that would be possible only by safely backing down on the load at the most expensive fuel points. The net evaluation of all of these considerations was a decision to proceed with a condensing unit.

The expected load of the Indiana & Michigan Electric Company for 1939 is shown in Fig. 1 and the place expected to be occupied by the new unit on that load curve. It will be noticed that not only has it been possible to develop an almost complete base location on that load curve for the new unit, but that the present units have been fitted at a load factor of more than 70 per cent, and the utmost advantage has been taken of the limited amount of hydro available. The curve does not show the condition during periods when capacity may be reduced on the system by emergency or normal outage, nor does it show a definite allowance for spinning reserve. Both of these items are, however, fully taken care of by interconnection arrangements. Besides, a considerable amount of interchange capacity will be available, both of the diversity and the economy type, and during those periods the present plant will be available for these purposes. It is necessary to remember also that there are some 20,000 kw. of secondary capacity available on the system entirely adequate for that purpose.

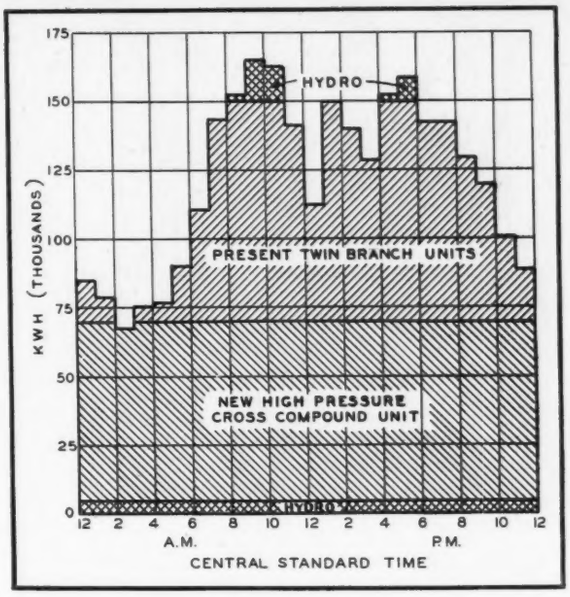


Fig. 1—Typical winter daily load curve expected by time new unit is in operation

Reason behind high pressures

There were three possible and practical ways of adding condensing capacity at Twin Branch. The first and the easiest thing that could have been done would have been to continue the present pressure of 650 lb. A second alternative would have been to have adopted the next standard pressure above that, either at 850 lb. or 1,400 lb., with a temperature of from 900 deg. to 940 deg., and the elimination of reheat. The third was the possibility of exploring higher pressures with a view to reducing the combined capital and operating costs. In considering these various alternatives, the thought here was kept in mind that though the proper time for superposition at Twin Branch had as yet not been reached, nevertheless it was unthinkable that the time would not arrive within the next ten-year period. In other words, somewhere around that time it would be found uneconomical to continue to operate a 25-year-old plant at any high load factor. It was felt, therefore, that in making the present exploration of the possibilities for better economies it would be well to keep in mind the likelihood of the adaptability of some of the present work toward possible future revamping or rejuvenating of the present still economical but gradually obsolescing 650-lb. generating plants.

In evaluating the considerations outlined above, and those about to be mentioned, sight also must not be lost of the fact that the background of experience and the path of progress on the American Gas & Electric system from the time Windsor was first developed, and going through the cycle of Philo, Twin Branch, Stanton, Deepwater, Logan and back again to Windsor, had in every case been along the line of pushing out to the furthest point of the known and safe limits on steam and turbine temperatures and pressures, provided the economics of the situation justified such advance. Thus, the pressures chosen, for example, at Philo in 1923 and at Deepwater in 1928, which had been generally looked upon as radically high, had, with the passage of time, been proved to have been not radical at all, but entirely conservative and sound; they were merely in advance of the general status of the art.

Preliminary investigation having shown that considerable economic gain was possible by going to higher pressures, a series of all possible cycles was explored. The accompanying table abstracts the result of that study with reference to four cycles given serious consideration. Some of these have been used at plants generally well known, and cycle No. 3 is substantially the Windsor and Logan

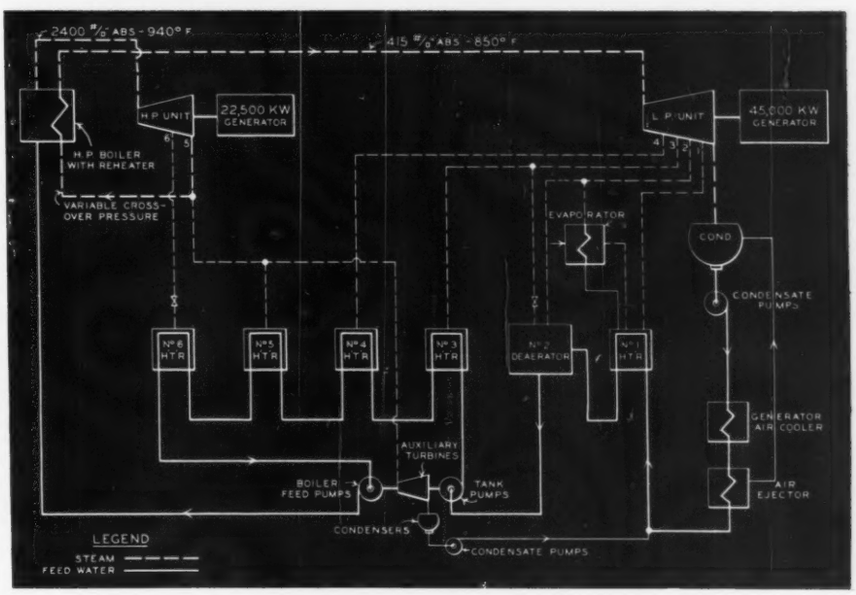


Fig. 2—Flow diagram in preliminary stage

cycle. It will be noticed that although the thermal gain between cycle No. 3 and cycle No. 1 is only of the order of 7 per cent, there is another gain having even a more vital bearing on the problem, namely, the gain in high-pressure capacity, and that represents a gain of 32 per cent. This has not only a material bearing on the economics of higher pressure but also has a very vital bearing on the question as to what pressure and what blocks of high-pressure capacity will be available for superposition on the series of 650-lb. plants which went into service in the 1920-1930 decade, among which Twin Branch is one, when that group is finally modernized. It will be observed, too, from an examination of the table that the only economical cycle not given consideration was the mercury cycle. It was frankly felt that in the light of the technical difficulties that have been encountered heretofore in the expansion of the size of the mercury boiler, in particular, that no consideration of this cycle was warranted, particularly if economies approaching the order of those obtainable by mercury could be obtained by a straight steam cycle. With that much as a settled background, the next consideration involved an investigation of the technical possibilities and limitations of 2,400 lb.

Boiler more critical than turbine

It was felt at the outset that the turbine would set no particular limit on the pressure, but that the boiler would require careful investigation. A thorough study was given to the circulation problems that would be involved at pressures up to 3,000 lb., and the final consensus indicated that 2,400 lb. (2,500-lb. drum pressure and 2,400-lb. outlet pressure at the superheater) would be the limit at which a boiler with natural circulation should be built. Above this pressure there seemed to be no question but that forced circulation would be required, as in the case of European boilers. As expected, the pressure of 2,400 lb. selected as a limit for the boiler proved to be no stumbling block in the turbine design. Investigations of boiler feed pump design, suitable for pressures up to 3,000 lb., had been progressing at the same time. These studies indicated that existing designs could be adapted to the proposed pressure, if intelligent use were made of the metals available so that pump maintenance would not be materially increased.

Having become satisfied on the technical soundness of the problem, there remained to be considered the more difficult part, namely, the economics of the proposed development. It is apparent, of course, that the economics are determined by two factors, *viz.*, the additional cost of going to the higher pressure and temperature and the counterbalancing factor, the benefits, of whatever nature, deriving as a result of the higher pressures and temperatures. In this connection the economics of the situation were materially strengthened by, first, the new boiler code, which meant no materially heavier boiler tube thicknesses for the pressures under discussion than the present standard for 1,400 lb.; second, the development of the various ideas of boiler design into concrete shapes, which made it highly desirable and almost mandatory that the utmost simplicity in drums, tubes and surfaces and in circulation circuits be employed; this had the double advantage of simplifying the boiler considerably and of reducing the size of tubes and other elements, thus reducing expense; third, a co-operative spirit in the development of the new design displayed by the leading manufacturers who finally participated in the development because it definitely promised a more economical method of generating power.

When the additional cost on the designs developed was evaluated against the benefits, both from a capacity and from a thermal standpoint, it was found that there was full and adequate justification for proceeding with the higher pressure development. In view of our accumulated experience, going back over more than two decades, which showed an unfailing eventual reduction of the cost differential between the more economical and less economical power generation cycles as experience and standardization were accumulated, and in view, further, of the possibilities that such a step offered toward helping to solve the problem of eventually modernizing the existing 650-lb. plants, it was finally decided to proceed with the higher pressure.

The cycle is straight regenerative reheat

The proposed cycle is a straight regenerative-reheat type (Fig. 2). This is still in its preliminary form and will doubtless have to be modified in details as the design progresses. Its outstanding features are the direct line, simple flow characteristics so typical both of the Logan and the Windsor cycles, with a variable crossover pressure at a maximum of 415 lb. This pressure is substantially the same as that utilized at the Deepwater, New Jersey, plant. A variable crossover pressure gives a much flatter efficiency characteristic than has been possible to obtain in the present cycle of superposition plants using a fixed crossover pressure. The use of turbines for boiler feed pump drive permitted, in this case, not only economical variation in speed but a speed greater than is possible with the highest speed 60-cycle motor. As will be seen, it is planned to drive the tank pumps from the main boiler feed pump turbine. The forced and induced draft fans, it will be noticed, have not been made turbine-driven, the present thought being that because the simplicity of the boiler gas passages reduced the forced- and induced-draft fan power, variable drive or its equivalent can be obtained more economically than by small turbine drive, but whether this will be obtained by vane control or by electrical variable drive, such as the thyratron motor, etc., has not yet been determined.

Another unusual feature of the heat cycle is the idea of exhausting the boiler feed pump turbines into a separate condenser instead of to a

Summary of Relative Efficiencies and High-Pressure Capacities for Four-Heat Cycles

Cycle No.	Description of cycle	Net station heat rate in per cent	* High-pressure capacity for fixed L-P capacity in per cent
1	2,400 lb. abs., 940 deg. F., 900 deg. F. reheat, 1 in. Hg. abs.	100	178
2	1,200 lb. abs., 940 deg. F., 850 deg. F. reheat, 1 in. Hg. abs.	102.9	135
3	1,200 lb. abs., 940 deg. F., no reheat, 1 in. Hg. abs.	107.3	135
4	850 lb. abs., 940 deg. F., no reheat, 1 in. Hg. abs.	108.4	100

* All low-pressure units have 400 lb. abs. throttle pressure.

heater using main condensate. It is believed that this will yield a higher financial efficiency and ease of operation, but the question has not been definitely settled as yet.

Expected performance of the cycle has not been indicated in Fig. 2. Nor is it possible without the thorough knowledge and evaluation of other heat cycles, class of fuel employed, types of turbines, etc., to make a direct comparison between the performance of this cycle and other existing cycles. But it is expected that the relative difference between this and, for example, the three other cycles which were seriously considered will be at least the amounts shown in the table.

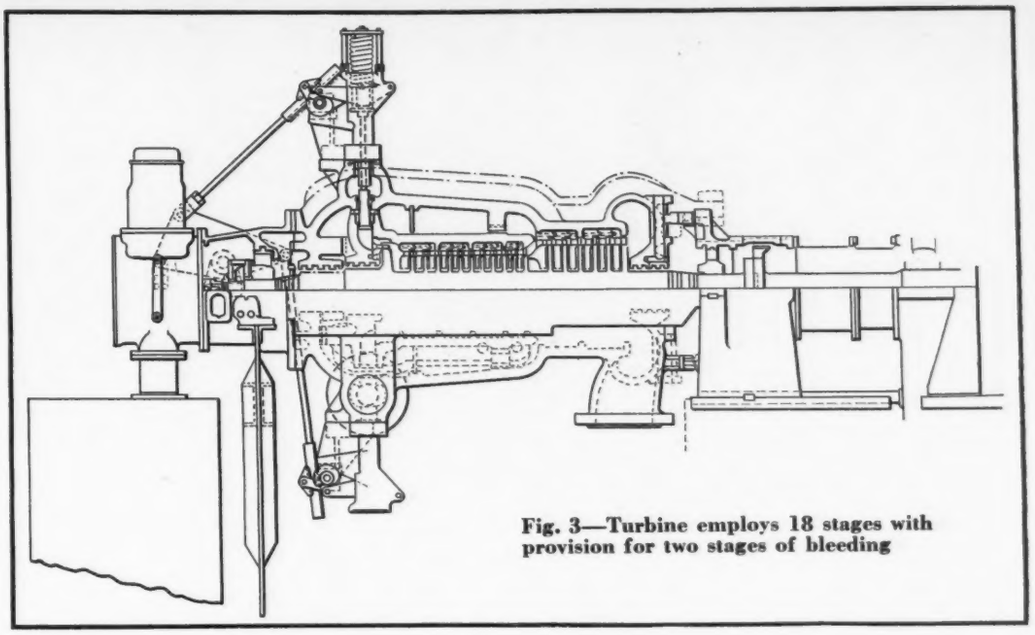


Fig. 3—Turbine employs 18 stages with provision for two stages of bleeding

For example, the high moisture and hydrogen content of the Indiana coal (approximately 10,500 B.t.u. per lb.) to be used precludes boiler efficiencies of higher than 85.8 per cent with stack temperatures of 350 deg. F. Also, lower stack temperatures are not economically justifiable because of high sulphur content. This obviously handicaps the net performance of the plant merely because of the method of figuring boiler heat balance based on the high heat value of the coal, but the relative performance for the fuel that has to be utilized in the Twin Branch location remains unchanged on that account.

Turbines, pumps, condensers

The high-pressure turbine will be of General Electric manufacture and will be similar (cross-section in Fig. 3) to the double shell design that was developed for the Logan 40,000-kw. unit and the Windsor 60,000-kw. units; that is, it will have a single stop valve and six control valves. A comparison of this with the cross-section previously published for the Windsor units[3] will show that the new turbine follows the Windsor design, but has been increased from twelve to eighteen stages. The unit will be rated at 22,500 kw., 2,300 lb. absolute throttle pressure at a temperature of 940 deg. F., exhaust pressure of 470 lb. absolute, and will operate at a speed of 3,600 r.p.m. Provisions will be made for two stages of bleeding on this turbine.

Generator will be hydrogen-cooled and, except for the smaller size, will be similar to the 60,000-kw. Windsor generator; that is, it will have internally mounted, tubular hydrogen coolers. Excitation will be by direct-connected exciter and pilot exciter. The short-circuit ratio will be approximately 89 per cent.

The low-pressure turbine will be a (17-stage) 45,000-kw. unit with four bleed points and will operate at a speed of 1,800 r.p.m. Normal throttle pressure will be 415 lb. absolute and normal temperature of 850 to 900 deg. F. The alternator will be a 45,000-kw., 90 per cent factor machine, operating on a closed air system. Excitation will be by direct-connected exciter and pilot exciter. It will, of course, be possible to operate this unit when the 2,300-lb. turbo-generator is out of service. It will also be possible, and arrangements are being made, to operate the high-pressure boiler feed pump turbines from the existing 650-lb. boilers when the new boiler is being brought up to pressure and before the 2,300-lb. turbine can supply steam to the boiler feed pump turbines. It is of interest to note that, with the exception of the boiler feed pumps, most of the auxiliary equipment supplying the 67,500-kw. cross-compound unit will be no larger than that which had been supplied for the existing 42,000-kw. units. This applies particularly to the condenser, condensate pumps, forced- and induced-draft fans and other auxiliaries. This factor also is an additional gain in favor of the high pressure selected.

The Foster-Wheeler condenser will be of the single-pass, welded steel plate shell construction with tubes rolled at both ends.

The three Ingersoll-Rand boiler feed pumps will be turbine-driven to obtain variable speeds higher than 3,600 r.p.m. The casings of these pumps will be of the barrel type. In addition to the normal supply from the high-pressure 22,500-kw. turbine, provisions will be made for running the boiler feed pump turbines from the existing 650-lb. steam boilers. It has not been decided whether to exhaust the turbines to feedwater heaters or to their own condensers using river water.

Boiler meets circulation problem

The main boiler problem, that of proper circulation, is caused by the relatively small difference in weight of the water and steam at 2,400 lb., which emphasizes the need for providing simple circulation passages and large down-comers to obtain proper hydraulic head. The design finally evolved a boiler with very little convection surface in the boiler proper, except a few rows of tubes immediately in front of the superheater. The boiler will be of Babcock & Wilcox manufacture with a rating of 550,000

[3] "Windsor Steam Plant Modernization," Philip Sporn, *Combustion*, March, 1937.

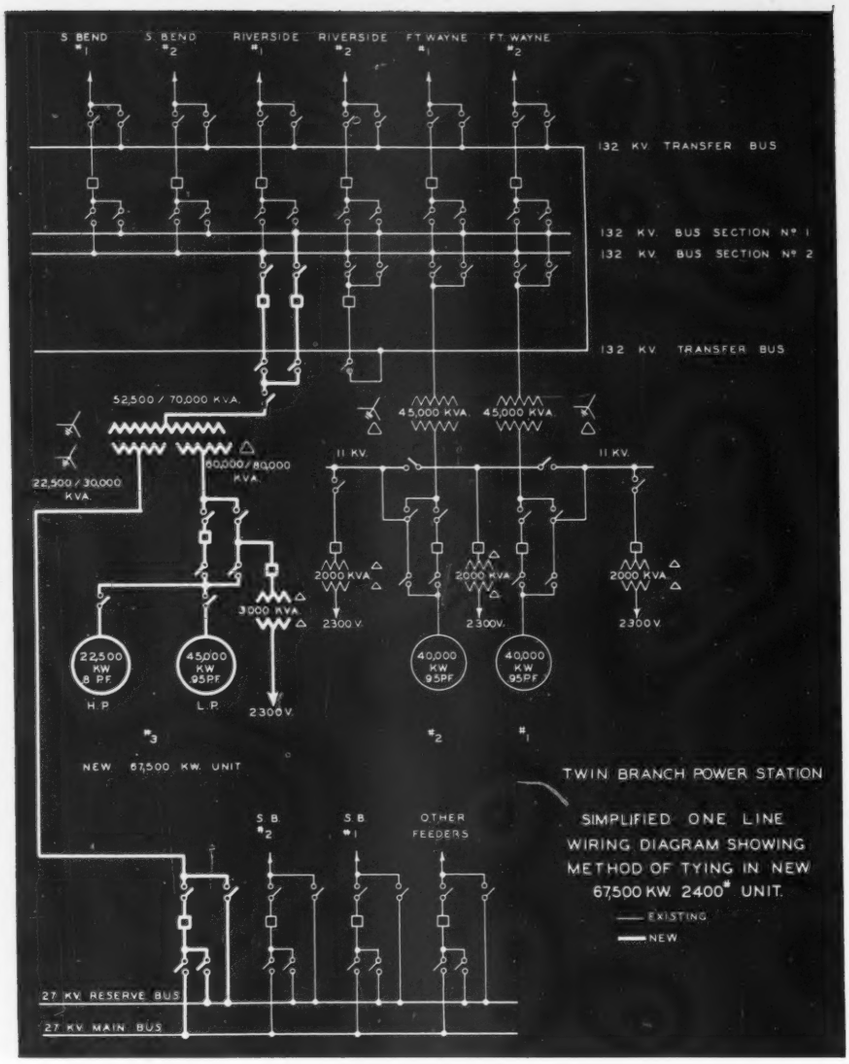


Fig. 4

lb. of steam per hour at a superheater outlet pressure of 2,400 lb. and temperature of 940 deg. F. The integral reheater will be designed to handle 450,000 lb. of steam per hour at a pressure as high as 450 lb. and will reheat to a range from 850 to 900 deg. F. As might be expected, practically all of the heat transfer surface in the furnace and boiler is vertical, the only exception being the tubes underneath the wet furnace bottom and the tubes on the top of the primary furnace; the superheater and reheater are vertical. Only convection (no radiant) surface will be used for the superheater, with a by-pass provided for temperature control. It is expected at the present time that the reheat surface will be confined to the two side walls of the furnace.

The large portion of the heat input concentrated in the radiation to the furnace walls will, it is believed, definitely preclude the slagging of the upper region of the furnace. The economizer will be of the return bent tube type and the air heaters will be of the Ljungstrom type.

The wet furnace bottom will provide for continuous discharge of slag that will drop over into the ash hopper and water sluicing system. Reference to the load curve, Fig. 1, will indicate the consistency of the selection of a wet bottom furnace in line with the reasons published for the selection of a dry bottom type for Logan.[4] This is emphasized also by the fact that only economical sources of fuel give coals with softening and fusing temperatures of 1,850 deg. F. and 2,100 deg. F. respectively, whereas at Logan it was found necessary to provide for burning coals having fusion temperatures up to 3,000 deg. Therefore, while Logan was expected to handle load variations of 4/1 and was designed for load variation of 5/1, the load curve of the Indiana & Michigan Electric Company and the Indiana General Service Company systems indicates that there is little likelihood of the 2,400-lb. extension being called upon to carry loads under 50 per cent of normal rating.

Three B & W table-type pulverizers will be used; the other boiler auxiliary equipment is standard construction.

Electrical end

The present two 40,000-kw. turbo-generators are stepped up each through its own transformer bank to a double 132-kv. bus from which six 132-kv. transmission lines radiate. At the time the original machines were installed sufficiently high speeds on breakers at 132-kv. rating to meet safe synchronizing were not available and low-tension breakers (Fig. 4) were installed for that purpose. At present the group of 132,000-volt feeders mentioned above operate off two continuously excited buses, one of each of the three groups of parallel lines being connected to each of the buses. For some time it has been evident that an additional source of supply for the 27-kv. transmission system serving the area in and around Twin Branch would be needed. The installation of the new 2,300-lb. unit has, therefore, been taken advantage of to provide an economical source of feed, this being obtained through a three-winding bank handling the output of the high- and low-pressure ends through an arrangement indicated in Fig. 4.

Switched as single unit

It will be seen that the plan contemplates the switching of the high- and low-pressure elements as a single unit and the tying in of the 132-winding of the three-winding bank by a duplicate set of breakers, one going to each of the two buses. This will permit balanced operation between the three units. Although a low-tension breaker is called for between the generators and step-up transformers, the sole purpose of this is to provide sectionalizing facilities for the generators so as to permit the use of the bank as a 132-kv. to 27-kv. transformer bank. No electrical transmission lines are called for, the existing network being more than adequate to absorb the increased power generated by the new unit.

[4] "Logan Steam Station—A Landmark," Philip Sporn, ELECTRICAL WORLD, April 11, 1936.

Stoker Water Cooled for Low Ash Fusion

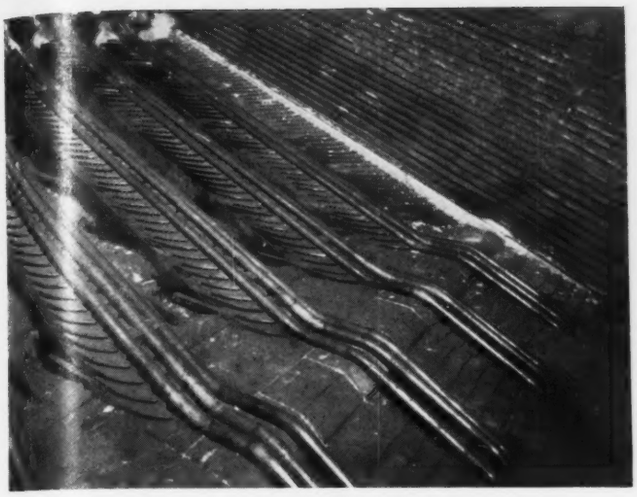


Fig. 1—First form. Cooling tubes in first form laid on tuyère stacks

Low Ash Fusion Temperature of Lower Cost Local Coal Made It Unsuitable for Ordinary Stoker Firing — Experiments in Water Cooling the Stoker to Reduce Temperature of Ash Resulted in Stoker Design That Is Giving Very Satisfactory Performance

By WALTER H. PROESCHOLDT
Iowa Electric Light & Power Company, Cedar Rapids

PRIOR to the advent of NRA and of the coal code that has succeeded it, coals from western Kentucky were principally used in the Cedar Rapids station of the Iowa Electric Light & Power Company. They could be obtained at reasonable delivered prices and, including boiler room maintenance, would produce steam at the lowest unit cost. Furthermore, the fuel-burning equipment, consisting of eight Taylor underfeed stokers, seven retorts each, equipped with dumping plates for ash disposal, was suitable for such coals. But with the present government regulation of coal production coal economics have changed considerably and western Kentucky fuel has become prohibitive in price for use in Cedar Rapids. After endeavoring to obtain coal from another source it was decided to try to burn coal from a strip mine in northern Illinois which was substantially lower in delivered price. A typical proximate analysis of this coal is:

Moisture	16	per cent
Volatile matter	37	per cent
Fixed carbon	37	per cent
Ash	10	per cent
Sulphur (separate determination)	3.2	per cent
B.t.u. lb. as fired	10,400	

Due to the low melting point of the ash (slightly in excess of 1,900 deg. F.) the stokers, designed about fifteen years ago, could not burn this coal at required ratings. When it was attempted molten ash soon closed off most of the air supply. After taking the boiler off the line and cleaning

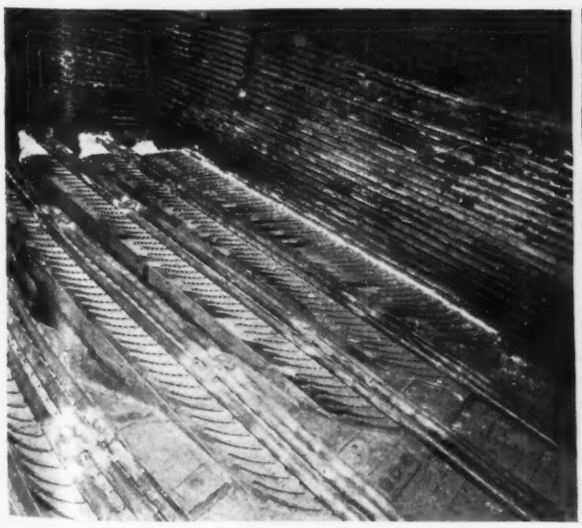


Fig. 2—Second form. Tuyère stacks moved forward to eliminate ledge in second form

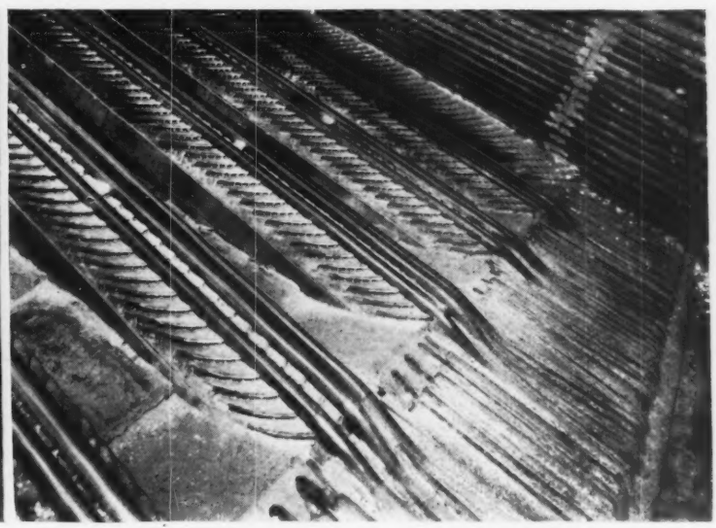
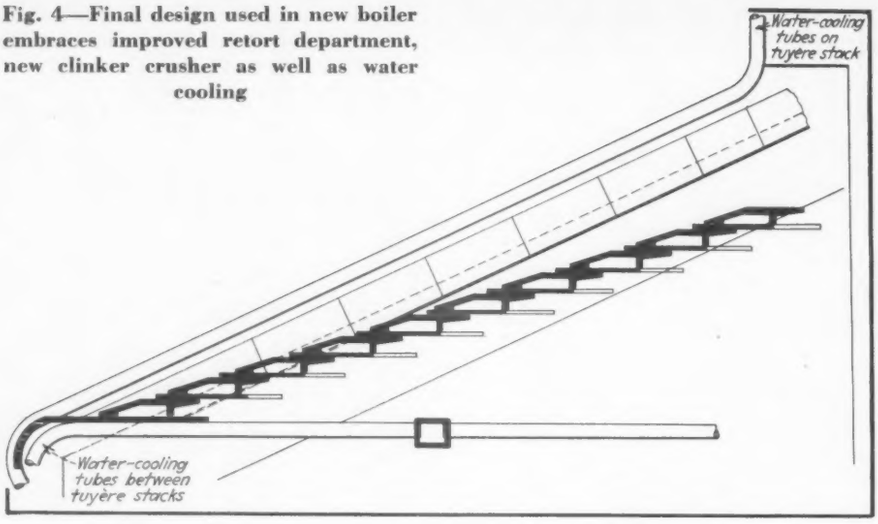


Fig. 3—Third form. Extension grates completely covered with cooling tubes in the third developmental form

Fig. 4—Final design used in new boiler embraces improved retort department, new clinker crusher as well as water cooling



the stoker it was found that the molten ash had badly burned the castings and had practically destroyed a large portion of the tuyère sections.

Manufacturer co-operates in design

Many attempts were made to change the design of the tuyère sections and various air admission parts of the stoker with only partial success. It was found necessary, during the first part of the experimental period, to cool the ash to a point below its fusion temperature if trouble-free operation was to be expected. Co-operating with the stoker manufacturer, the personnel of the Cedar Rapids power station designed and installed water cooling tubes on the tuyère stacks as illustrated in Fig. 1. The cooling water circulating through these tubes was connected into the Riley-LaMont water wall system which was placed in these boilers about ten years ago.

Cooling the tuyère sections materially improved conditions in the furnace, made the fuel bed more porous and allowed air to pass through it. Most important of all, molten ash did not flow down on the tuyère stacks, causing burning of the stoker parts and shutting off the air supply. The principal effect of the cooling tubes was to freeze the molten ash quite some distance up in the fuel bed, thereby allowing air to pass through it freely.

While cooling of the tuyère sections was very beneficial, trouble developed when the ash reached the non-cooled extension grates at the lower end of the stoker. Here the ash accumulated in a huge mass of about the consistency of chewing gum, making further travel very difficult. Fig. 2 shows the appearance of the stoker after the tuyère sections were moved forward in an attempt to promote better travel by elimination of the ledge evident in Fig. 1. This was helpful, but molten ash would still adhere to the movable extension grates between the cooling tubes. Fig. 3 shows the final result after the movable extension grates were stopped and completely covered with water cooling tubes. Ash readily passed over these tubes and onto the dumping plates, from which it was readily disposed.

Maintenance cost cut

Since the seven old stokers have been water cooled approximately 353,000 tons of coal have been burned by these units at an average stoker maintenance of 2.84 cents per ton. When the age of these stokers is taken into consideration, and that also a portion of the experimental expense is included therein, this is a remarkable performance. The first water-cooling tube was placed in the furnace approximately three years ago; it was recently removed, and no appreciable wear could be discerned. Such performance shows that the abrasive action of the moving coal and ash is a minor factor.

About two years ago a new seven-retort stoker of the same size as the other seven stokers was installed. Since its installation 47,000 tons of coal have been burned on it at an average maintenance cost of 1.26 cents per ton of coal. This figure also includes some experimental work on the stoker. The seven old stokers are equipped with dumping plates for ash removal, while the new one is equipped with crushing rolls. To keep radiant heat from remelting the ash after it reached the ash pit, when operating at high ratings, it became necessary to change the design of the toe of the stoker by decreasing the width of the top of the ash pit in such a way that the cooling of the tubes would be more effective. After this was accomplished 19,000 tons of coal were burned at an average maintenance cost of 0.8 cent per ton of coal. The difference in maintenance expense between the new and old stokers is a measure of maintenance expense which may be expected due to stoker age.

Water cooling for new stoker ordered

Based upon experience gained from the "home-made" water-cooled stokers it was decided to install a water-cooled underfeed stoker in the new 300,000-lb.-per-hour steam generator now being installed in the Cedar Rapids power house. Among other things, the following factors were considered: First cost, reliability, maintenance, over-all efficiency, maximum possible output and power consumption.

There are several unique features in the design of the new stoker in addition to the water cooling. One of the principal points is retort design. Fig. 4 shows in principle the design of the retort, which has variable depth, being deeper at the coal admission point and gradually decreasing in depth to the toe of the stoker. It is believed this design will result in a more uniform depth of fuel bed above the tuyère stacks and will offer approximately the same resistance to air over the entire stoker area. However, this point must be proved by actual operation, which will begin very shortly. Thermocouples are being insterted in various parts of the stoker in order to study this problem further.

Another point of interest is the design of the steel clinker crushers. Teeth are installed in a staggered pattern on the roll in such a way that only a few are actually in the grinding position at a time. This reduces the demand for power required in clinker grinding and materially reduces stresses and loads on supporting steel.

As natural circulation design is used, only two 3-in. water-cooling tubes on each of the tuyère stacks are being installed in the new stoker, whereas the water-cooling tubes on the old stokers consist of three 1½-in. tubes (OD) on each tuyère stack.

Rural Extensions Increase

Utilities Adding 200,000 Customers on 41,000 Miles of New Lines in 1937—Construction 28 Per Cent Above 1936—Trend Is Toward Longer Spans

RURAL electrification to be completed in 1937 is surpassing the rate achieved in 1936. It is surpassing forecasts made at the beginning of the year, both as to miles of line and as to number of customers. It is proceeding at virtually the same rate during the second half as during the first. New construction will total 41,000 miles, compared with 32,000 miles last year. Customers added on these new lines will number 202,580 in 1937, an increase of 19.5 per cent over the corresponding figure, 169,470, in 1936.

Of the new construction this year the completion of 20,700 miles is indicated for the first half year, 20,300 for the second. Customers also are almost equally divided, 102,860 in the first and 99,720 in the second half-year.

These conclusions are based on a survey just completed by ELECTRICAL WORLD. Because of the splendid cooperation on the part of the electric light and power industry, only a small portion of the growth had to be estimated. Reports were received from 293 companies, which serve a total of 20,829,000 customers of all classes. According to statistics published by the Edison Electric Institute, the total number of customers served by the entire industry at the end of 1936 was 26,206,000. This number includes municipal establishments. Based on the latest available census, the number of these that were served by privately owned utilities may be taken as 23,760,000. The coverage of the present survey, therefore, was 87.7 per cent. The analysis has been carried through, similarly, by geographical divisions.

Privately owned companies only

It should be pointed out that these statistics refer to privately owned companies only. No attempt was made to include municipal plants. No account is taken of extensions serving co-operatives, financed by REA funds. Nor do the statistics in general cover customers added on existing lines, with the exception of a few reports in which the total of new rural customers was given, rather than those on new extensions.

The 293 companies constructed 28,052 miles of rural line in 1936, 18,062 in the first half of 1937 and expect to complete another 17,787 miles during the second half, making a total for 1937 of 35,849 miles. Correspondingly, these 293 companies reported 147,956 customers on the new rural lines in 1936 and 176,995 in 1937. These are totals actually reported. Adjustment for 100 per cent coverage in each division gives the mileage and customers in Table I.

With minor exceptions, all regions show greater growth in 1937 than in 1936, the East North Central and West South Central being conspicuous in that respect. The two North Central regions are adding more customers during the second half year than they added in the first, approximately balancing diminished gains elsewhere, so that the national total for the second half is only 3 per cent under the first half.

As the lines are extended into new territory, they are bringing in fewer customers per mile. That is evident from Table II. Taking the country as a whole, the average for the reporting companies in 1936 was 5.28 customers per mile. It fell to 4.96 in the first half of 1937 and 4.92 in the second half. There are some regional exceptions and further diversity in individual cases, but in general the statement holds true. Further extensions will reach the economic limit—where it has not already been reached—unless cheaper forms of construction can be devised, adapted to thinner territory.

Wide variations appear, as between

Table I—Rural Line Construction, 1936 and 1937

Miles of line and number of customers by Geographical Regions

Region	Miles of Rural Line Added			Rural Customers on New Lines		
	1936 Year	1937 First Half	1937 Second Half	1936 Year	1937 First Half	1937 Second Half
New England	913	625	595	4,395	3,145	2,760
Mid. Atlantic	6,950	3,780	3,855	33,680	17,680	17,150
E. No. Central	10,390	7,195	7,375	50,100	34,220	37,050
W. No. Central	2,212	1,066	1,375	10,250	4,370	5,560
South Atlantic	5,575	3,250	2,794	32,540	17,680	15,210
E. So. Central	1,870	1,593	1,405	12,100	8,170	6,520
W. So. Central	1,737	1,790	1,528	9,270	8,420	7,020
Mountain	723	577	496	5,275	3,325	2,610
Pacific	1,609	822	885	11,860	5,850	5,840
United States	31,979	20,698	20,308	169,470	102,860	99,720

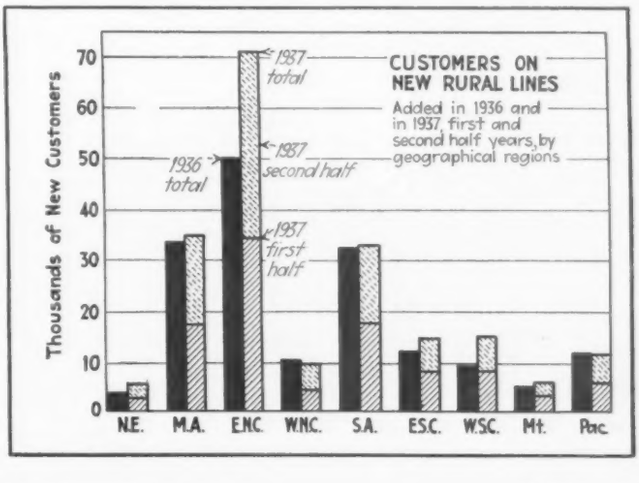


Table II—Customers per Mile of Rural Line Constructed in 1936 and 1937

Region	1936 Year	1937 First half	1937 Second half
New England	4.82	5.03	4.63
Mid. Atlantic	4.83	4.68	4.43
E. No. Central	4.82	4.75	5.02
W. No. Central	4.63	4.09	4.05
So. Atlantic	5.83	5.43	5.45
E. So. Central	6.48	5.12	4.63
W. So. Central	5.34	4.63	4.58
Mountain	7.32	5.78	5.28
Pacific	7.38	7.13	6.62
United States	5.28	4.96	4.92

different sections of the country, in the proportion of new rural customers compared with all customers. For the entire country there were 7.1 of the former per thousand of the latter in 1936, 8.5 in 1937. As might be anticipated, the regions with a large proportion of urban population, combined with existing high saturation of rural electrification, show the smallest increase per thousand of total. That is notably the case in New England and the Middle Atlantic States, and to a less degree on the Pacific Coast.

A trend toward the use of longer spans is revealed by Table IV. Of 242 companies reporting on this item, average spans of less than 200 ft. were listed by 32 companies in 1936, 26 in the first half of 1937, 23 in the second half. The number using spans between 200 and 250 ft. also decreased. From 250 ft. upward, the number increased. The preponderance of short and medium length spans in the "heavy loading" territory, especially New England, and of long spans in the South is clearly indicated.

A concomitant of this is the trend toward the use of line conductors of high tensile strength and the diminishing use of plain copper shown in Table V.

Very few reports mentioned lines constructed by the government or with federal aid. One Western company, which reported no new rural lines or customers, states that "at the present time all rural lines are built by customers, mostly with REA help."

A letter from one in the grain belt—a company that built several hundred miles during 1927 and 1928 in what was then its best rural areas—includes this paragraph: "Some of the better rural areas where we would normally construct lines have been solicited by the several county rural co-operatives anticipating federal government assistance. These co-operatives petitioned the state commission for transmission line franchises covering practically all the highways in the county on which we do not have lines. Their actual construction is very slow, and in a few cases where service has been established less than 25 per cent of the lines for which they petitioned have been built. We feel that farmers will soon become tired of the delays, which in many cases have been more than two years, and we will again take up a normal rural extension program."

Table III—Customers on New Rural Lines per Thousand Total Customers

Region	1936 year	1937 First half	1937 Second half
New England	2.02	1.44	1.26
Mid. Atlantic	4.78	2.51	2.43
E. No. Central	8.82	6.02	6.52
W. No. Central	4.96	2.11	2.69
So. Atlantic	17.85	9.68	8.35
E. So. Central	23.20	15.70	12.52
W. So. Central	7.15	6.50	5.41
Mountain	8.13	5.13	4.03
Pacific	5.45	2.69	2.68
United States	7.10	4.39	4.18

Table IV—Length of Span in Feet, by Geographical Regions

Number of Companies Reporting Each Length — 1936, 1937 First Half, 1937 Second Half

Region	Year	Under 200	200+	250+	300+	350+	400+	450+	500+	Total
New England	'36	15	6	7	2					30
	'37[1]	11	9	8	2					
	'37[2]	10	8	8	3	1				
Middle Atlantic	'36	2	5	6	5	8	3	1	2	32
	'37[1]	2	3	6	4	9	4	2	2	
	'37[2]	2	3	6	4	8	5	2	2	
E. No. Central	'36	9	7	2	19	12	2		1	52
	'37[1]	8	6	6	19	9	3		1	
	'37[2]	6	6	8	17	11	3		1	
W. No. Central	'36	4	4	7	14	9	2		1	41
	'37[1]	3	4	7	14	9	3		1	
	'37[2]	3	3	8	15	8	3		1	
South Atlantic	'36		2	2	5	2	6		5	22
	'37[1]		2	1	6		8		5	
	'37[2]		2	1	6		8		5	
E. So. Central	'36			1	2	1		1		5
	'37[1]			1	2	1		1		
	'37[2]			1	2	1		1		
W. So. Central	'36		1	2	5	4	4	4	5	25
	'37[1]	1		2	4	4	4	5	5	
	'37[2]	1		1	6	4	3	6	4	
Mountain	'36	1	1	2	10		1	3	2	18
	'37[1]		2	2	8	1	1	3	2	
	'37[2]		2	2	7	1	1	3	2	
Pacific	'36	1	2	5	4		1	1	3	17
	'37[1]	1	1	5	5		3	2	2	
	'37[2]	1	1	4	5		3	2	2	
United States	'36	32	28	34	66	36	19	10	17	242
	'37[1]	26	27	38	64	32	24	13	18	
	'37[2]	23	24	39	65	34	26	14	17	

Table V—Conductor, Rural Lines

Number of Companies Reporting Each Kind— 1936, 1937 First Half, 1937 Second Half

Region	Year	Copper	Copper-weld or CW & C	ACSR or Aluminum	Alum. & Copper or CW	Steel	Total
New England	1936	19	2	6	3		30
	1937[1]	21	2	4	3		
	1937[2]	20	4	4	2		
Mid. Atlantic	1936	12	8	8	4		32
	1937[1]	11	11	7	3		
	1937[2]	11	11	7	3		
E. No. Central	1936	16	21	12	3		52
	1937[1]	18	20	12	2		
	1937[2]	18	20	12	2		
W. No. Central	1936	10	13	14	4		41
	1937[1]	10	13	14	4		
	1937[2]	9	14	14	4		
So. Atlantic	1936	5	2	13	2		22
	1937[1]	5	2	13	2		
	1937[2]	6	2	12	2		
E. So. Central	1936	3	0	2	0		5
	1937[1]	2	0	2	1		
	1937[2]	3	0	1	1		
W. So. Central	1936	7	8	10	0		25
	1937[1]	6	10	9	0		
	1937[2]	6	10	8	1		
Mountain	1936	12	3	2	0	1	18
	1937[1]	8	4	4	0	2	
	1937[2]	8	5	3	0	2	
Pacific	1936	11	4	1	1		17
	1937[1]	11	3	1	2		
	1937[2]	9	4	2	2		
United States	1936	95	61	68	17	1	242
	1937[1]	92	65	66	17	2	
	1937[2]	90	70	63	17	2	

July Operations Show Gains

Energy sales, 12.5 per cent over 1936, set new record — Appliance loads are filling in the summer valley — Revenue up 7.1 per cent

RISING 7.1 per cent above last year's total for the same month, the revenue of the electric power and light industry from ultimate consumers during July amounted to $179,637,400, according to the Edison Electric Institute. This was 0.6 per cent more than in June and 3.1 per cent more than in May. The amount of energy generated increased 9.1 per cent compared with a year ago to 9,864,939,000 kw.-hr., of which 31.9 per cent was produced from water power. The monthly production was the largest on record, slightly exceeding that of December, 1936, but the average daily output failed, by a narrow margin, to match that of June.

New record for consumption

Although production was greater than in July, 1936, there was almost no increase in the amount lost or unaccounted for and somewhat more energy was purchased from other sources. As a result the increase in sales to ultimate consumers, 12.5 per cent, was greater than the increase in energy generated. These sales in July surpassed the previous maximum recorded last January.

In particular, the kilowatt-hours to large commercial customers, which may be taken as an indicator of industrial activity, have been steadily rising since February and for four consecutive months have established new all-time records. The rise, however, is less steep than it was last year, for the margin of gain has decreased from 24.8 per cent in March to 13.4 per cent in July.

Sales for domestic use, in contrast, have increased their lead over 1936 from 13.6 per cent in May to 18.2 per cent in July. These figures are significant in that they show a progressive filling in of the summer "valley," due presumably to an ever-broadening appliance load. To indicate the progress in that direction it need only to be pointed out that as recently as 1930 the domestic sales in July were only 63.8 per cent as great as in January. This year the ratio was 82.2 per cent.

For the latest twelve-month period the average consumption per customer for domestic use was 770 kw.-hr.; the average rate dropped to 4.51 cents.

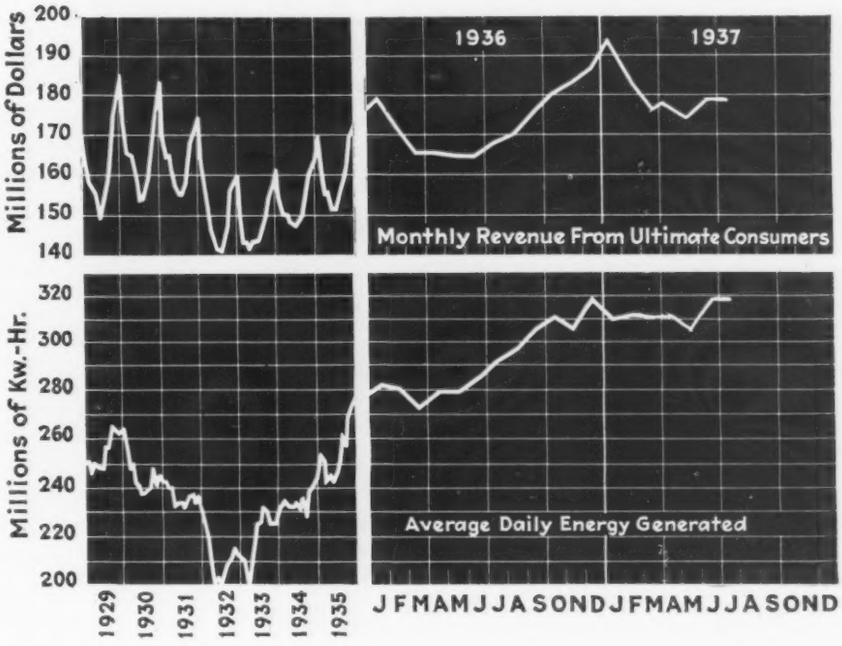


Table I—Monthly Revenue from Ultimate Consumers and Energy Output of the Electric Light and Power Industry

Compared with Corresponding Month of Previous Year

Month 1937	Revenue from Ultimate Consumers‡		Energy Generated, Millions of Kw.-Hr.*					
			Total		Hydro		Fuel	
	Thousands of Dollars	Per Cent Inc.	Gen.	Per Cent Inc.	Gen.	Per Cent Inc.	Gen.	Per Cent Inc.
July	179,637	+7.1	9,865	+ 9.1	3,160	+12.1	6,705	+ 7.8
June	178,539	+8.9	9,563	+12.4	3,491	+19.0	6,072	+ 9.0
May	174,287	+6.3	9,459	+11.9	4,103	+15.5	5,356	+ 9.3
April	177,861	+7.3	9,335	+13.1	3,859	+ 6.0	5,476	+18.6

* By courtesy of Federal Power Commission, with deductions for certain plants not considered electric light and power enterprises. ‡Edison Electric Institute.

Table II—Allocation of Energy by Classes of Service, 1937

Compared with Corresponding Month of Previous Year (Edison Electric Institute)

Class of Service	July		June		May	
	Millions of Kw.-Hr.	Per Cent Inc.	Millions of Kw.-Hr.	Per Cent Inc.	Millions of Kw.-Hr.	Per Cent Inc.
Total for distribution*	10,113	+10.4	9,819	+13.6	9,703	+13.7
Lost in transmission, etc.	1,657	+ 0.8	1,492	+ 8.4	1,589	+ 9.8
Sold to ultimate consumers	8,456	+12.5	8,327	+14.6	8,114	+14.5
Domestic	1,371	+18.2	1,342	+17.3	1,323	+13.6
Com'l, small light and power	1,497	+13.7	1,463	+14.8	1,399	+10.5
Com'l, large light and power	4,944	+13.4	4,889	+16.5	4,727	+18.9
Municipal street lighting	140	−18.1	136	−14.5	147	−18.4
Railways — street, interurban	333	− 2.8	327	− 5.6	346	− 2.2
Railroads — electrified steam	100	+ 1.7	98	+31.1	104	+34.5
Municipal and miscellaneous	71	+ 3.1	72	+ 5.3	68	+ 0.8

* Generated, purchased from other sources, imported, less energy used in railway and other departments.

Editorials

Steam vs. Hydro Has New Debater on Steam Side

STRIDE after stride has been made in the last five or six years to increase the gap between the costs of hydro and of steam-generated power. The decision to employ 2,400-pound pressure at the turbine in the extension of the Twin Branch power plant on the American Gas & Electric system is the latest and most impressive of these advances toward most economical and reliable energy supplies. The National Resources Committee recently asserted that water-power plants are usually more expensive than steam plants for equally good service and that the high efficiency and low fixed charges now possible in large fuel-burning plants place hydro-electric development at a disadvantage in most sections of the country. Insofar as the ultimate costs for this plant prove to be in keeping with the objectives of the design, so far will it become one more case in point substantiating that assertion.

Technically the innovations at Twin Branch will set the pace for design of the immediate future. The heat cycle is remarkably simple, involving small deviation from the prevailing dominant superposition trend except as to reheat. In introducing reheat, the objective was not so much a gain in thermal efficiency as an increase in the total unit rating coupled with higher efficiency. No new basic turbine development seems to have been necessary. Combining into a single boiler the main boiler elements, the superheater and reheater will undoubtedly create some problems in balancing heat surfaces and gas flows. But the choice of the radiant wall as a reheater surface obviously makes simpler the problem of the balance between it and the connection superheater.

Much as the courage and alertness of the A.G.&E. engineers can be applauded for these technical advances, the significance of Twin Branch's 2,400-pound design rests in the long-range picture. How grand it would be if, five years hence, we could all look back on this milestone as labeling for posterity the episode that marked the turning point in political worship of "white coal." This plant will be acclaimed as far more than a technical monument if it starts a chain of events which will persuade government to drop its uneconomical and technically ill-considered program of hydro-electric development. Steam is getting to be at least as simple, twice as economical and three times as romantic as water power.

Management Appraises Balanced Load Building

IN THIS and a succeeding issue there is presented for the first time a very complete record of the way in which a modern concept of load building can be developed for a large number of operating companies and then be applied by them to achieve unusually good results in terms of over-all profitableness to the respective companies.

Conceding at the outset that the basic scale of rates is one component in the ratio, we may immediately proceed to the assertion that adding residential load at 3.09 cents per kilowatt-hour, commercial load at 3.17 cents per kilowatt-hour and power at 0.99 cent per kilowatt-hour is ample proof of the efficacy of what Middle West calls "balanced" load building.

Once again the industry is reminded that load building is a problem of management, not solely a matter of mere appliance sales volume. For here is the management of one of the leading public utility organizations declaring that for system growth money is required; that whether the money is forthcoming depends on net revenue, and that there is no other source of net revenue than new load.

Here, succinctly expressed, is today's management policy as expressed by a management which inherited more than its quota of problems and yet today operates as a going concern in the face of lowered rates coupled to higher taxes and higher operating expenses.

The way out of this management problem was load building, and this management now looks to more expenditures of effort and money to achieve greater results. The results of three years of effort can now be classified and analyzed in some detail for 28 companies, and fortunately the data made available to ELECTRICAL WORLD now permit such an analysis of costs and results to be made.

The concept of balanced load building is fairly well understood by the industry. Here, now, are some results.

•

Detroit Furnishes Evidence on Highway Safety Lighting

NIGHT lighting of heavily trafficked roads and intersections for driving safety has made some progress in the past two years, but when one studies the results secured in Detroit with improved lighting, it is apparent from the standpoint of public welfare that the progress has been much too slow.

In the 31 miles of streets in Detroit's "night accident area" there was a ratio of seven night fatalities

to one daytime fatality before improved lighting was installed. After the new lighting was in service the ratio dropped to 1.2 to 1. Had this improved ratio been effective in 1934 and 1935 some 80 or 90 lives would have been saved. That is nearly three lives per mile of street.

No more substantial evidence is needed to prove that adequate lighting of the right kind will reduce night-driving accidents and save lives. The electrical industry should find that such results will bring the co-operation of state highway officials, automobile clubs, insurance companies and others interested in promoting safe driving.

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Farm Production Use Studies Needed

FARM electrification experts are agreed that rural lines can be profitable and can be extended into thinner territories when the major use of energy on the farm is for productive rather than household uses. The question has always been how to develop these productive uses.

One approach which might offer some possibilities is that of labor saving. The farmer has been beset with the problem of labor. Can he meet this problem with electricity? Have we facts to prove our point? Do we know how much labor a milking machine will save, or a water system, or a spray pump, etc.?

In other words, cannot the farm productive uses of energy be approached in much the same way as the utilities and manufacturers approached the problem of electrifying industry?

Where there is a satisfactory supply of labor available these labor-saving devices might increase the productivity of a farm with the same labor supply by transferring back to the farm many of the operations that now are farmed out. Grain can be milled on the farm, fruit sorted and stored, milk processed instead of being sent to the creamery, etc.

May it not be possible, also, that a return of processing of agricultural products to the farm as the result of electrical machinery will attract back to the rural areas some of the labor that left the farm to go into the factory? Many of the boys went to the city because they saw nothing ahead but drudgery.

Aside from the greater usage of electricity, the social and rural economy possibilities in the electrification of productive uses on the farm are far reaching. They need further study, both of an economic and engineering nature.

The Committee on the Relation of Electricity to Agriculture has just completed an engineering analysis of electrical uses on the farm which contains a wealth of data on energy consumption, connected load, equipment used and similar information which is of interest to the electrical industry. This is a good start, from which should be carried forward studies equally searching in nature of the economic advantages of electricity to the farmer in agricultural production.

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Generating Bus Structures Go Metal Clad

MODERNIZATION of an old generating station is a major operation which must not only meet present-day needs, but must incorporate technological improvements that avert all the insufficiencies of the past and safeguard the whole investment against obsolescence for the extended life of the plant. The modernization of Waterside station in New York reflects not only these factors, but also a significant forward stride in bus construction for generating stations.

Operating experience of the last few years has focused attention on station sectionalization and adequate protection of equipment. With the large concentrations of power on today's electrical galleries, it is natural that the first line of defense should be a form of bus and switch structure arrangement offering a high degree of station reliability against shutdowns. In this realm, it is certain that bus structures for generating stations have not kept pace with the development of switching and protective equipment in general. Metal-clad equipment has had attractiveness in this direction, but it carried the handicap of a feeling among engineers that apart from its higher cost, the increased fire hazard from oil and insulating compounds more than offsets the installation and operating advantages afforded. Possibly metal-clad equipment has also been handicapped by the persistence of the manufacturers in associating the metal-clad feature with oil circuit breakers and other equipment in such manner as to detract from the flexibility in station arrangement so earnestly desired by the designers.

Waterside Station presents a new type of metal-clad bus construction which, despite the stringent space limitations imposed upon it, offers some of the advantages of separated phase installations and permits the benefits of factory assembly. It also promises to contribute high reliability, minimized fire hazards (due to reliance only on air and ceramic insulation), along with low installation and maintenance costs and simplified operation. As soon as all these desirable objectives are confirmed by the operating experience, it is reasonable to assume that the novel departure in design will prompt much more resort to the metal-clad principle in generating station bus structures.

A Sacrifice to Justice

By CARTER FIELD

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This noted journalist gives his personal comments and interpretations on current happenings affecting the electrical industry. His background and his location at Washington make his thoughts informative and interesting even though all may not agree with him.

SOME very shrewd prognosticators are predicting that the Supreme Court of the United States will hold for the government and against the electric companies in practically every one of the important cases involving the power industry expected to be decided this winter.

These include such far-reaching questions as whether the federal government has the right to subsidize local government—by grants, and loans at low interest—in competing with privately owned electric systems, and whether the court will go further in approving sale of electric current by the government, if "incidentally produced," as covered by the first TVA decision, or not.

Six months ago the legal consensus obtainable around Washington—garnered from men who are astonishingly adept at figuring out what view the high court will take on any given case—was that the government would lose every one of these cases. But the same "experts" figured that the high court would hold the Wagner act unconstitutional by a majority of either five to four or six to three.

The theory of that reversal of form is of profound interest at the moment to the electric industry, because the "experts" have no doubts whatever in their own minds as to why they were wrong in that case. They predict that the same mental processes which led two of the justices of the high court to vote on the "liberal" side in the Wagner act decision will lead them to join with the extreme liberals in voting on the cases expected to be decided by the court in the term just opened.

There is no way of proving it, of course, because neither of the justices who is suspected by the experts of having "switched" on the Wagner case is going to admit it, but Washington very generally agrees that there *was* a switch on the Wagner act, and also as to the reason for it.

This generally accepted theory is that two of the justices thought it was vitally necessary for them to surrender their own views as to the limitations of the Constitution, because not to surrender on that would mean pouring water on President Roosevelt's wheel in fighting for his bill to enlarge the Supreme Court. To vote against the Wagner act would enable the President to say to the country: "Just see how necessary it is to have younger men, and more men, on the high court."

And most senators will admit privately that the Waterloo of the President's court-packing battle was the day the court held the Wagner act was constitutional.

Now let's apply this same logic to the power cases pending and soon to be pending before the Supreme Court. President Roosevelt went out West to feel the pulse of the country. Some thought he would talk about the necessity for enlarging the high court, especially as there has not been the slightest trace of doubt that he would continue this fight.

He did not mention the court fight. But he laid great stress on the value of the water developments. He promised "more dams on the Columbia" in the very same speech in which he stressed the necessity for economy, and predicted that the government would balance the budget in 1939.

Parenthetically, there is not a Chinaman's chance of Mr. Roosevelt balancing the budget in 1939 except by sharply boosted taxation. There will be petty economies here and there, but there will be big spending also. "More dams on the Columbia" is the key to that.

But the President was doing his best to work up enthusiasm about the water resource developments. Back in Washington the justices of the high court read in the newspapers of the enthusiasm in the West for more and bigger power developments by the government. Every newspaper man on the Presidential special seemed to be impressed by the utter lack of interest in the President's court battle, but the very vivid interest in federal spending.

Putting two and two together, the same experts who failed to guess the court accurately on the Wagner act now demand to know how the same justices can fail to follow the same course and beat a strategic retreat to a stronger position?

Obviously, these experts point out, the justices may consider it expedient to give in on the power question in order that the court may be left still in a position to protect the country after the present storm has blown over! Bear in mind that these experts are firmly convinced that a majority of the members of the court could not possibly have believed that the Wagner act was entirely within the federal powers. There was nothing personal in this action of the justices. They surrendered something not for any selfish reason, but to preserve something else far more important, as they saw it, to the country.

On which theory the prediction is now being made that the justices will sacrifice the private electric business this time to make sure that Roosevelt does not get a chance to put five additional Hugo Blacks on the high bench!

News OF THE WEEK

Louisiana Steam Generating Plans to Install New Boiler and Turbine

Expansion program involves expenditure of $2,800,000 — Increased demand both for steam and electricity from industrial customers makes new generating equipment necessary — Water supply a problem

An expansion program involving approximately $2,800,000 will be undertaken in the near future by the Louisiana Steam Generating Corporation, subsidiary of Engineers Public Service Company, at its Baton Rouge station. The new installation is expected to be completed by December, 1938.

The company plans installation of a 500,000 pounds per hour steam boiler at 650 pounds pressure and a 15,000-kw. or 20,000-kw. turbine generator. The bleeder turbine can produce at 150 pounds into a process steam line or condenser. This will be the first condensing unit in the station. The capacity of the plant now is 45,000 kw., all bleeding units.

Use several fuels

While the fundamental fuel is natural gas, the boilers are also fired with petroleum waste, soda bottoms, wax tailings, acid sludge and petroleum coke. This type of fuel is obtained from the nearby refineries which are served by Louisiana Steam Generating with both steam and electricity. The plant now has a steam capacity of more than 1,000,000 pounds per hour and with the new unit to be installed the output will be greatly increased to meet growing demands for both electricity and steam.

The water supply and its treatment before use presents one of the major problems for the plant. The water is drawn from the Mississippi River and precipitated. When drawn off clean it is then put through a softener process before going to the boilers. When the present plant was constructed in 1930 it was the largest water softener plant in the world.

Equipment wear heavy

Steam comes out of the boilers at 760 deg. F. and after going through the turbines is exhausted into the steam lines for industrial users. There is no return of distillate. This means that the boilers are constantly using treated water. Because the plant is not a closed system the boilers and turbines are forced to meet the unusual condition of using new water, which, the company states, means heavy wear on equipment.

Stone & Webster Engineering Corporation, which constructed the original plant, will be in charge of construction and installation of the new boiler and turbine.

The demand for electricity from industrial customers in the Baton Rouge area has increased to the point where new generating equipment is necessary to meet the load. Last year the company delivered more than 115,000,000 kw.-hr. to the Gulf States Utilities Company, in addition to supplying the needs of Baton Rouge.

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Challenges PWA Allotment

Adding another item to the long list of pending cases challenging PWA loans to municipalities for power purposes, the Northwestern Public Service Company, Inc., has applied to the U. S. District Court for the District of Columbia for an injunction to prevent Administrator Harold L. Ickes from disbursing a $400,000 PWA allotment to the city of Columbus, Neb., for the construction of a municipal distribution system and street lighting system.

The grant of $180,000 and loan of $220,000 was announced August 24 as part of the new PWA program covering "moral obligation" projects. Test cases raising the same issues are now awaiting argument before the U. S. Supreme Court and a decision is anticipated this fall.

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Nebraska Utilities in Construction Work

Construction totaling nearly $5,000,000 is planned or has been completed recently by the two largest Nebraska utilities.

The Nebraska Power Company is constructing a $1,200,000 steam-generating plant at South Omaha which will supply both steam and electric service to Armour and Swift packing companies. The plant, to be completed by June 1, 1938, will include two 175,000-lb. boilers and one 5,000-kw. back-pressure turbine. The packing companies, which previously have been generating their own steam and purchasing electric service from the utility, will take steam at two pressures, 160 and 20 lb.

In addition, the utility recently completed a $1,500,000 addition to its steam-electric generating station in Omaha. The installation involved a 12,500-kw. high-pressure topping turbine, operating at 1,200-lb. pressure and 915 deg. F., and exhausting into an existing 15,000-kw. turbine, the combination being used as a unit.

Finally, some $800,000 to $1,000,000 is budgeted for distribution expenditures during the year.

Approximately $1,100,000 will be spent this year by the Iowa-Nebraska Light & Power Company on new and reconstruction of electric projects in eastern Nebraska and southwestern Iowa, according to L. R. King, vice-president and general manager. Biggest item in the construction program will be a 15,000-kw. plant addition at York, Neb.

Allocation of the expenditures: Plants, $382,000; substations, $150,000; transmission lines, $242,000; distribution lines, $132,000; services, transformers and meters, $100,000; miscellaneous, $34,000.

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Duplication, Waste Seen in "7-TVA" Plan

Establishment of the proposed seven additional regional planning agencies, modeled after the Tennessee Valley Authority, would lead only to duplication and waste, the United States Chamber of Commerce declared in a report made public last week. A special committee's report was based on the results of a referendum to the 1,500 member organizations of the chamber.

Existing federal and state agencies are developing and conserving the nation's natural resources at the present time, the report said, adding that the proposed change would lead to further postponement of flood-control works.

"The disruption of established flood-control policies is only one example, though a very important one, of the nature of the changes that the regional plan would bring about in numerous federal departments," the report continued.

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New Hydro Plant for Quebec

The Brown Corporation, pulp and paper manufacturer, and the St. Maurice Power Corporation plan the construction of a $15,000,000 power plant on the St. Maurice River, near La-Tuque, Quebec. Four of an ultimate six vertical hydro-electric units of 40,500 hp. will be installed, giving a present capacity of 162,000 hp., under a 104-ft. head. Power in excess of that used by the paper company will be taken by the Shawinigan Water & Power Company.

Pacific Gas & Electric to Build $5,000,000 Steam Power Project

35,000-kw. generating plant to be constructed at Avon refinery of Tide Water Oil Company — California commission approves contract between oil concern and utility — Refinery to take steam and power

Construction of a 35,000-kw. high pressure steam-generating plant by the Pacific Gas & Electric Company at the refinery of the Tide Water Associated Oil Company at Avon, Calif., will be undertaken early next year. The plant is expected to be completed in April, 1939, and is estimated to cost $5,000,000.

The contract between the utility and the oil concern has been approved by the California Railroad Commission. It provides for the oil company selling petroleum sludge, fuel oil and similar combustibles to the utility and the utility selling electric energy and steam to the oil concern.

To double load

Tide Water is to undertake an electrification of its refinery which will about double its connected load, but even with this completed the demand will only be about 8,000 kw., leaving P. G. & E. with considerable capacity available for feeding into its transmission system.

Generation will be at 12,000 volts, stepped down to 2,300 volts for service to Tide Water and stepped up to 110 kv. for transmission.

One turbine will be installed, taking steam at 1,500 lb., 925 deg., from three boilers, each capable of furnishing 200,000 lb. per hour. The turbine will operate either condensing or non-condensing, with steam bled off for delivery to the refinery at 160 lb., 50 deg. superheat.

Demand charge for electric service will be $6,250 a month up to 5,000 kw. and $1.20 a kilowatt a month for excess. Quantity charge will be ½ mill plus 0.0021 bbl. of fuel oil or equivalent a kilowatt-hour.

Demand charge for steam will be $2,000 a month for 275,000 lb. an hour or less. Quantity charge will be 2 cents and 0.265 bbl. of fuel oil per 1,000 lb. for the first 125,000,000 lb. per month and 1½ cents and the same fuel rate for excess.

The plant will also be equipped to burn natural gas, available from a nearby line.

The refinery has a load factor between 75 and 80 per cent and a power factor close to 97 per cent.

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Court Asked to Void Ruling on Utility Act

Test of the constitutionality of the public utility act moved another step forward this week when Electric Bond & Share asked the Circuit Court of Appeals to reverse the decision of Judge Julian W. Mack, who had upheld the registration provisions and declared the provisions separable.

Thomas D. Thacher, as attorney for the utility, challenged the act in its entirety "as an attempt to control normal business transactions, investments and corporate relationships in an industry primarily local in character and without regard to the regulation of commerce or any other matter within the constitutional sphere of federal control." Mr. Thacher declared that "its objectives are not the regulation of commerce but the public interest and the protection of investors and consumers."

Counsel for the utility held that the "control provisions not only transcend the limited powers of Congress, but, ignoring the requirements of due process, transfer the responsibility of corporate management to federal commissioners."

Robert H. Jackson, special assistant to the Attorney-General, argued that the utilities were violating the intent of the act by not registering.

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Spencer-Charlton 66 Kv. Line

The new "Polarm" line of the New England Power System running between Spencer and Charlton, Mass., described in ELECTRICAL WORLD September 11, 1937, page 100, as a 22-kv. circuit, is operated at 66 kv., for which it was designed.

Electric Commercial Equipment Sales Due for 50 per cent Rise

Pressing need seen for co-ordinated promotion by manufacturer and utility — Speakers at Commercial Electric Cooking Council urge more publicity and sales promotion — Dooley sees encouraging outlook

An increase of 50 per cent over 1937 in electric commercial equipment sales was the quota announced this week by Philip M. Alden, chairman Commercial Electric Cooking Council, to representatives of more than 40 utility companies and of the representative equipment manufacturers at the first meeting called by the council. Sessions were held last Monday at the Allerton Hotel in Chicago.

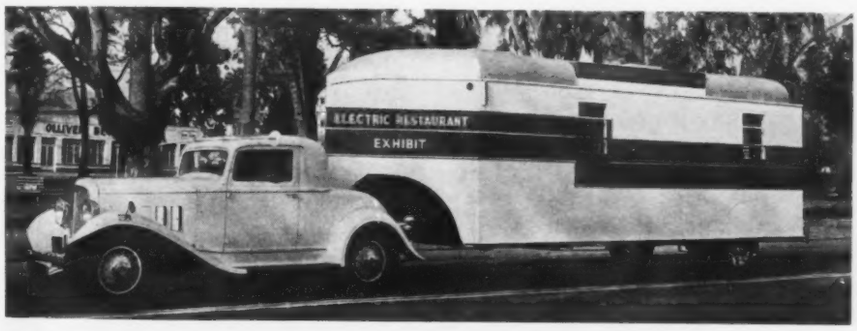
A highly encouraging outlook for commercial load increases during 1938 was seen by the first speaker, Henry G. Dooley, associate editor of ELECTRICAL WORLD, due to general need of utility companies for more revenues which could be supplied by sale of high-wattage, long-hour use of commercial cooking equipment. He quoted utility management sources as vitally interested in building load that was compensatory to the utilities and reported that these sources are encouraging new high levels in commercial sales.

The present need for more publicity and sales promotion on a more co-ordinated basis was the keynote expressed by J. M. Welch of Edison General Electric Appliance Company and supported by other speakers. Exhibits of 78 pieces of national advertising by equipment manufacturers were shown and represented an expenditure during 1937 of more than $200,000, Mr. Welch said.

The manufacturers' viewpoint was a subject discussed by F. H. Emery, chairman Waters Genter Company, by Claude Miller of Silex Company, Grant Call of Edison General Electric and M. E. Miner of Griswold Manufacturing Company. Points stressed by these speakers were: Utility need for definite selling plan, manufacturers' responsibility to the ultimate user and, most of all, the pressing need for coordinated promotion by the manufacturer and the utility.

The utility company view was discussed by A. Leslie Weiss, Utility Management Corporation; T. I. Messenger, Buffalo, Niagara & Eastern Power Corporation of Buffalo; Frank Richards, Consumers Power Company, Grand Rapids, and S. L. Cipperly, Southern California Edison Company, Los Angeles.

Round-table discussion of wiring cost subsidies, training and remuneration of salesmen, equipment finance plans and trial installations terminated the first joint commercial conference held since 1930.



SELLING COMMERCIAL SERVICE—This traveling coach helped Southern California Edison Company put 4,000 kw. of commercial load on lines, with revenue of $130,000, promotion cost of 33 cents per dollar, S. L. Cipperly told the Commercial Electric Cooking Council this week in Chicago

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SmithNamedChairman of Middle West Corp.

Purcell L. Smith, vice-president of Commonwealth Edison Company, was elected this week to the newly-created post of chairman of the board of Middle West Corporation, successor to Middle West Utilities Company, former Insull unit. At the same time Daniel C. Green resigned as president and director of Middle West.

Although Mr. Smith's election had been anticipated, the resignation of Mr. Green came as a complete surprise. He had guided Middle West destinies since 1933 as trustee and later as president.

It was reported that a new chairman was sought mainly to broaden and enhance the directing personnel of Middle West and that there had been no rift between the management and controlling interests.

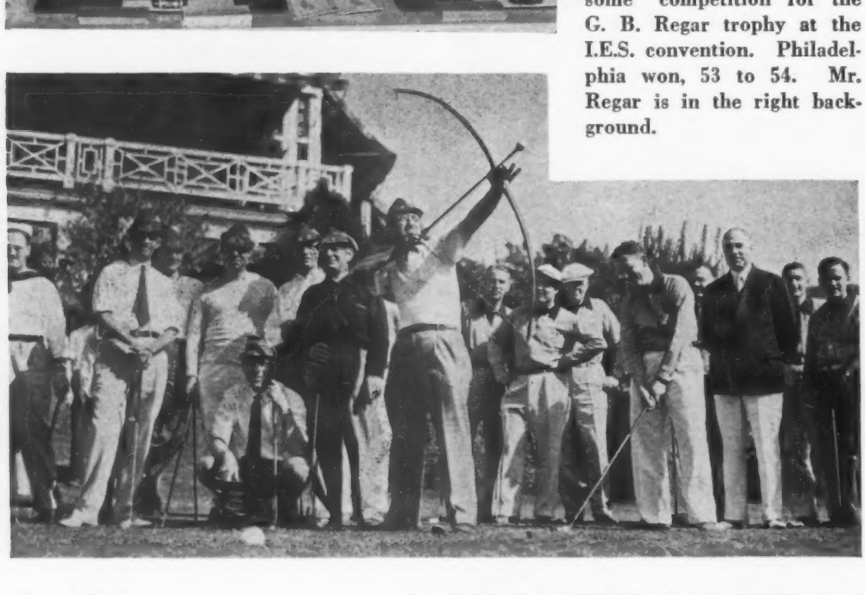
Planned Selective Load Building Urged to Increase Utility Revenue

Lighting conference and illuminating engineers at annual meetings stress opportunities in sales efforts to gain best results — Sharp says lighting returns a very high net — Commercial lighting discussed

The creation of net revenue through planned selective load building was the theme of the thirteenth annual National Lighting Sales Conference held in conjunction with the annual convention of the Illuminating Engineering Society at White Sulphur Springs, W. Va., last week. The program, which was devoted almost entirely to the commercial lighting market, was developed by E. J. Ingram, Metropolitan Edison Company, as the result of a questionnaire which showed the greatest interest to be in utility sales plans and methods.

Lighting is a base load builder, according to Howard M. Sharp, Buffalo, Niagara & Eastern Power Corporation. Speaking at the annual convention of the Illuminating Engineering Society last week, Mr. Sharp stated that lighting returns a very high net over a long period of time, requires very little added investment to serve, no repairs or servicing, no bonuses and but a minimum of reselling to maintain usage level. To sell lighting requires specialists, good training and supervision, demonstrations, follow-ups and job analyses to secure results. Wiring layouts are helpful and all specifications should be written. Records and reports are essential, but they should be made simple. Co-operation with the electrical trade will bring the best results.

CHECKING IN—Prof. Henry B. Dates, new president (left), and G. Bertram Regar, retiring president of the Illuminating Engineering Society, registering at the 31st annual meeting held last week at White Sulphur Springs, W. Va.



A MOBSOME—Karl Staley, with bow and arrow, tees off for New York section, while A. S. Turner starts for Philadelphia in the "mobsome" competition for the G. B. Regar trophy at the I.E.S. convention. Philadelphia won, 53 to 54. Mr. Regar is in the right background.

The profit-building value of a sales activity, it was stated by Leslie Weiss, Utility Management Corporation, New York, is the measure or "yardstick" of the effort. The factors which enter into this yardstick of profit are (1) market research to determine a sales objective, (2) sales effort in man-power, direction and promotion, (3) low operating expense through sales of long hours of use and high power factor and (4) the sale of lighting loads with minimum peak responsibilities.

Customer use analyzed

There are 86,000 commercial customers in Philadelphia with an average bill of $10 a month, declared J. F. Gaskill, Philadelphia Electric Company. They represent about one-quarter of the dollar volume. Of these, 42 per cent are unprofitable and 78 per cent of these unprofitable customers have less than 1 kw. of billed demand, yet more than 65 per cent require the addition of 75 kw.-hr. per month or less to place them in the profitable class. To meet this problem, a high-grade sales personnel is required, limited in size starting at 2,000 customers per man. To get maximum and steady coverage requires a junior group for market cultivation, unified sales control, advertising and co-operation with manufacturers.

Luminous store front lighting load can be developed by the utility, according to G. M. Rankin, Southern California Edison Company, and T. H. Shepherd, Department of Water and Power of Los Angeles, in seven ways: (1) Advertising, (2) follow-up of leads, (3) staff creation of ideas adaptable to each situation, (4) co-operation with light-conscious architects, (5) train others in the industry, (6) secure financing, and (7) arrange a good maintenance contract.

Lighting customers were divided, by R. L. Zahout, Connecticut Light & Power Company, Hartford, into three groups according to the need for lighting: For selling, for seeing, and for economic production. Several installations in each group were cited.

Advertising results seen

Sales management must be tolerant as to speed with which advertising can aid in producing results, H. S. Metcalfe, West Penn Power Company, Pittsburgh, stated, if advertising is to cease being a riddle. Also, the

utilities must have a profound conviction of the soundness of their appeal and, finally, they must have a passion for telling in every way the beneficial results from good lighting.

Inadequate wiring costs the utility company considerable lost revenue because the capacity is too small to carry higher lighting load values, E. A. Brand, Buffalo, Niagara & Eastern Power Corporation, stated, in urging the conference to take advantage of the sales suggestions in the Handbook of Interior Wiring Design.

Results from a questionnaire to school officials which produced 18 per cent in five days showed 90 per cent as replying that better classroom lighting improves scholarship, it was stated by H. W. Cooper, Wisconsin Power & Light Company. In 55 per cent of the replies the services of a lighting engineer were needed.

Dramatization, decoration, effective utilization of wattage and higher intensities were enumerated and illustrated by J. L. Stair and W. V. C. Foulks as some of the trends in store lighting which have been given as impetus by the lack of restriction in modern architecture. A new trend in window display lighting using flexible illumination with stage technique, in contrast to flat lighting, was discussed by Fred M. Wolff.

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Value of California Utility Property Up

Valuation of all privately owned utility property in California for 1937 was set at $1,003,746,210 by the state Board of Equalization, as against $976,846,320 in 1936. The board, in turning over the utility tax roll to the county auditors for local taxation, made public the fact that requests for valuation cuts totaling $79,000,000 had been denied the utilities.

Pacific Telephone & Telegraph Company and the Southern California Telephone Company had requested cuts totaling $45,000,000. The request for a cut of $772,050 by the Southern California Edison Company was the only one allowed.

A. G. Mott, chief of the board's utility valuation division, said the Southern California Edison Company's total valuation, despite the reduction, stands at $131,509,340, or $5,440,940 in excess of the valuation last year.

Mill Engineers View Electricity Application in Steel Operations

Development in power production, low-voltage distribution, cable engineering, electrical testing and run-out table drives discussed at convention of the Association of Iron and Steel Engineers

Distribution of low-voltage energy as a prime factor in the design and operation of electric systems in large industrial plants was brought out into the foreground of discussion at the convention of the Association of Iron and Steel Engineers in Chicago last week.

D. C. Nelson, Jones & Laughlin, pointed out that the total connected horsepower of low-voltage auxiliary equipment may exceed the main drive capacity in a modern steel mill. Effort to save money in low-voltage distribution may easily prove to be mistaken economy if it results in failure or poor performance of necessary auxiliaries.

Accurate knowledge needed

The growing appreciation in industry of the need for accurate knowledge and close control of electrical equipment performance was presented by Birger Thele, Tennessee Coal, Iron & Railroad, in his paper describing the electrical testing department of a large steel plant. "There is no question," said Mr. Thele, "about the necessity and the great value of frequent electrical testing in a steel mill and in coal and ore mines."

The squirrel-cage motor with frequency change speed control has been generally accepted as the final answer in run-out table drive, but in the large modern mill that may have as much as 2,000 hp. on the run-out the direct-current roll motor offers competitive advantages, stated L. A. Umansky, General Electric. With the large losses in a.c. drive that result from motor starting and stopping and from the necessary a.c.-d.c.-a.c. conversion, the saving of d.c. drive in energy cost alone may be of the order of $10,000 annually, not to speak of the probable canceling out of the higher price of d.c. motors by the lessened investment in space and equipment for conversion. But, of course, concluded Mr. Umansky, the decision in the specific case is a matter of cost analysis and study.

Power production received attention

D. C. Nelson

C. W. E. Clarke

Birger Thele

in two papers, one on "Steam Power Developments," by Charles W. E. Clarke, United Engineers & Constructors, and the other on "Turbine Developments, Their Application in the Steel Industry," by C. B. Campbell, Westinghouse.

H. Weichsel, Wagner Electric, in his discussion of surges and their effects on transformers, brought to the attention of the industrial electrical engineer a subject that has had intensive study in the utility field for many years. In their paper on selection of insulated cables for steel mills F. L. Aime, S. J. Rosch and R. B. Steinmetz, all of Anaconda Wire & Cable, reviewed the fundamentals of cable engineering and described the developments of late years in the art of cable manufacture.

The convention drew an attendance of about 500, and many more were attracted to the extensive Iron and Steel Exposition that accompanied it. More than 140 exhibitors staged an impressive display of steel mill equipment, principally electric, which demonstrated the high achievement of electrification in the modern steel mill.

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Community Promotion Aids Florida Utility

As a result of a state campaign sponsored by the Florida Power & Light Company and directed toward advertising Florida as a summer resort, the company had 9,800 more customers on its lines June 1, 1937, than on June 1, 1936.

In addition, disconnects in electric service in May slowed down as much as 23 per cent in some sections under the trend of previous years. Twice during the spring months the weekly electrical output reversed seasonal trends by increasing over the previous week's report, according to the company.

During April and May winter visitors were urged to "stay through May." Newspaper advertisements, radio programs, billboards, windshield stickers, window cards and a huge roadway electric sign carried this thought, with the results indicated above.

Beginning June 6 and continuing through July 15, "Summergrams," oversized postcards carrying Florida scenes on one side and space for message, plus a brief statement of the pleasant summer weather, on the other, were featured through the same advertising mediums. Floridians were urged to send the cards North, the utility paying postage on those cards mailed at the company's offices. Bernal E. Clark, the utility's advertising manager, was in charge of the campaign.

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REA Plant Opposed by Wisconsin Group

At its annual summer convention recently the Wisconsin Electrical Association went on record as opposing the proposed REA power plant at Eagle Point.

In a wire to John M. Carmody, REA administrator, the association labeled the project as "economically unsound in that it duplicates facilities already available where lower costs can be obtained" and recommended that "the project be stopped and the money made available for additional county REA development, thereby making service available to some 3,500 additional farmers who otherwise would not get electric service."

Speakers at the convention included: R. J. Nickles, Roy Springer, E. H. Herzberg, vice-president, president and managing secretary of the association, respectively; J. S. McMillan, Glen V. Rork, S. L. Hagen, Northern States Power Company, and I. L. Illing, Milwaukee Electric Railway & Light Company.

Officers will be elected at the annual convention this winter in Madison.

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Contractors' Annual Meeting to Be Held on Pacific Coast

Plans for the 35th annual convention of the National Electrical Contractors Association, to be held October 18-21 in Los Angeles, Calif., have been announced. Delegates from every part of the United States and Canada are expected to attend. The address of welcome will be made by A. L. Stone, chairman of the convention group.

Earl N. Peak, president of the association, will speak on "Electrical Industry Promotion." Also on the program are W. C. Mainwaring, British Columbia Electric Railway Company; Earl Whitehorne, editor *Electrical Contracting;* Walter L. Stickel, Electrical Development League of Southern California, and A. V. Thompson, General Electric Company. On Wednesday evening, October 20, the presentation of the James H. McGraw Contractor-Dealer Award for 1937 will be made.

Carolina High Court to Hear Rural Row

Counsel in the Johnston County, North Carolina, rural electrification dispute have agreed to submit their differences to the State Supreme Court. Johnston County citizens are seeking to restrain the Carolina Power & Light Company from building lines and from keeping an agreement with the board of directors of the Johnston County Electric Membership Corporation. The fight is between the power company and the REA. Directors of the co-operative, refusing an REA loan, signed a contract with Carolina Power & Light under which the utility company agreed to build rural electric lines.

The company had constructed approximately 170 miles of rural lines in Johnston County before it came to the agreement with the co-operative last June. Since then it has been actively engaged in building additional lines and is expected to have constructed most of the 325 miles it agreed to build before a decision is given on the appeal.

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A.S.M.E. Names New Officers; H. N. Davis Is New President

Harvey N. Davis, president Stevens Institute of Technology, was elected president of the American Society of Mechanical Engineers last week. Other officers named at the same time are:

Vice-presidents, F. O. Hoagland, master mechanic Pratt & Whitney Division, Niles Bement-Pond Company; B. M. Brigman, dean Speed Scientific School, University of Louisville (Ky.); Harte Cooke, mechanical engineer McIntosh & Seymour Corporation; W. H. McBride, consulting engineer, San Francisco; L. W. Wallace, director Division of Engineering Research, Association of American Railroads.

Managers: Carl L. Bausch, vice-president Bausch & Lomb Optical Company; S. B. Earle, dean School of Engineering, Clemson A. & M. College (S.C.); F. H. Prouty, partner in Prouty Brothers Engineering Company.

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New York Steam Plan Ruling

Consolidated Edison Company of New York, Inc., has declared the plan of exchange of New York Steam Corporation preferred for Consolidated Edison preferred effective as of September 25, two-thirds of the outstanding Steam preferred shares having been deposited for exchange under the plan by that time.

Sacramento Plans 201,000-Hp. Project

Sacramento Municipal Utility District has filed application with the Federal Power Commission for a preliminary permit to construct a 201,000-hp. hydro-electric project in Eldorado County, California, on Silver Creek and the South Fork of the American River. The district proposes the construction of the development in two steps, the first to consist of two storage reservoirs connected by a tunnel, a diversion dam, a conduit and a power house, to be known as the Brush Creek development, which will have an installed capacity of approximately 50,000 hp.

Ultimate development will consist of the enlargement of the two storage reservoirs and the construction of two additional diversion conduits and two additional power plants, to be known respectively as the Big Bend and Chili Bar plants, which will raise the total installed capacity to an aggregate of 201,000 hp.

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WDA Decision Appealed

An appeal to the state Supreme Court from the decision of Circuit Judge Alvin C. Reis sustaining the constitutionality of the Wisconsin Development Authority has been filed in the Circuit Court at Madison, Wis., by counsel for Theodore Damann, Secretary of State, who is being sued to force him to pay expenses incurred by the WDA.

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McNinch Changes From FPC to FCC; Shift Is Temporary

Frank R. McNinch became chairman of the Federal Communications Commission on October 1, following his resignation as chairman of the Federal Power Commission the preceding day. In accepting his resignation, the President reminded him that his shift in duties is for a temporary period only. It is generally understood that he will return to the power commission following his work in reorganizing the FCC.

One of the last official acts of Mr. McNinch was to administer a public rebuke to C. Edward Paxson, counsel for certain subsidiaries of the Associated Gas & Electric Company, for published criticism of the power commission's newly initiated drive against interlocking office holders in the public utility field. Mr. Paxson appeared before the commission on September 30, retracted the statement and submitted a full apology. After issuing the reprimand, the commission closed the case.

Wide World

ROOSEVELT AT BONNEVILLE—The President, in company with Mrs. Roosevelt and Gov. Charles H. Martin of Oregon, views Bonneville Dam, a keystone in the New Deal's power program in the Northwest, on his tour and urged wider distribution of power

New York Utilities Pay $1,300,000 Tax

Utility tax receipts in the state of New York for July amounted to $1,300,000, Mark Graves, Commissioner of Taxation and Finance, reports. Public utilities will probably pay 97 per cent of this sum and resellers of utilities' services the remainder. It is expected that the utility tax yield will show steady increases in the months to come, particularly in the lighting and heating fields, according to Commissioner Graves.

Passed at the last session of the Legislature for the purpose of raising funds for emergency relief, the law became effective July 1 and levies a tax of 2 per cent on the gross income or gross operating income of utilities for the period commencing July 1 and ending June 30, 1938. The act authorizes any city to enact a local law imposing a like tax at the rate of 1 per cent.

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Files Suit in Rural Row

Filing of a $10,000 property damage suit in Tiffin, Ohio, by the Lake Erie Power & Light Company was the latest development in the battle between the utility and the farmers who aided workmen in digging holes and setting poles for a proposed REA power line project.

The utility demands $10,000 for 24 poles and 868 lb. of copper wire which officials charge were either destroyed or carried away by the farmers. A new utility power line replacing the one destroyed by the farmers is now serving four customers.

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PWA Power Grant to Maine

The City of Lewiston, Maine, has received a PWA grant of $102,600 for construction of a hydro-electric generating station which will make use of water power from Lake Auburn and will permit modernization of city's present power plant.

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Plans New Generating Unit

Plans have been formulated by the Iowa Public Service Company for a $23,000 plant improvement program, involving the installation of a new generating set and a motor-driven circulating pump for hot water heating system.

Pacific Coast Group Plan Industry Study

More than 200 members of the Pacific Coast Electrical Association convened in San Francisco last week for the fall conclave of the northern division, to discover, through exchange of viewpoints in small groups, what problems of the electrical industry demand immediate study. President R. M. Alvord opened the meeting.

The customer's interest was emphasized in administrative services discussions headed by Harry C. Ross. This section recommended that periodic public relations audits be taken to determine public sentiment. It also launched a cost study of the important problem of appliance servicing, while its personnel committee devoted attention to training and selection of employees.

The operating economics section likewise regarded personnel problems as of such importance to operating men that it appointed a committee to meet jointly with that of the administrative group. D. D. Smalley headed the operating economics section. Particular attention was given to recent developments in static capacitors for power-factor correction, to the use of underground for serving new residential tracts, to topping turbines, to demand-meter problems and meter standardization, and to safety, particularly a discussion of the desirability of grounding transformer cases and other equipment.

The business development section, under leadership of H. C. Rice, had prominent architects as its guests at wiring and lighting discussions who were unanimous in saying that architects want sound, technical advice on electrical problems and too often are bothered by inadequately informed salesmen. Industrial men gave particular attention to small consumers as the most fertile field for new load. Considerable interest was shown in studies of the effect of air-conditioning loads on distribution equipment.

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N.E.W.A. Program Announced

Tentative program of the meeting of the National Electrical Wholesalers Association, to be held in Cleveland, Ohio, October 18-21, has been announced. On the opening day there will be three meetings of the executive committee and various commodity committees will hold sessions on the following day.

L. E. Latham, chairman of the executive committee, will address the opening session for members and guests on Wednesday, October 20. Dana T. Ackerly, counsel of the association, will address the convention, taking as his topic "The Electrical Wholesaler's Position from the Standpoint of Recent and Impending Legislation."

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Begins TVA Power Use

Consumption of TVA power will begin about January 1 in Memphis, Tenn., according to Thomas H. Allen, chairman of the city Light and Water Commission, who stated that bids for equipment necessary for final distribution would be opened about Oct. 28.

Meetings

National Safety Congress — Annual meeting, Kansas City, Mo., October 11-15. Paul Jones, director of publicity, National Safety Council, 20 North Wacker Drive, Chicago, Ill.

American Institute of Electrical Engineers—Middle Eastern District, Akron, Ohio. October 13-15. H. H. Henline, National Secretary, 33 West 39th St., New York, N. Y.

Electrochemical Society — Fall meeting, St. Louis, Mo., October 13-16. Colin G. Fink, secretary, Columbia University, New York, N. Y.

National Electrical Contractors Association—Annual meeting, Biltmore Hotel, Los Angeles, Calif., October 18-21. L. W. Davis, general manager, 420 Lexington Avenue, New York, N. Y.

National Electrical Wholesalers Association—Semi-annual convention, Hotel Cleveland, Cleveland, Ohio, October 18-21. Alfred Byers, secretary, 165 Broadway, New York, N. Y.

National Metal Congress and Exposition—Atlantic City Auditorium, Atlantic City, N. J., October 18-21.

American Welding Society—Annual meeting and welding exposition, Atlantic City, N. J., October 18-22. Warner S. Hays, managing director, 29 West 39th St., New York, N. Y.

Indiana Electric Association — Annual meeting, French Lick Springs, Ind., October 21-23.

National Electrical Manufacturers Association — Annual convention. Palmer House, Chicago, October 24-30. W. J. Donald, managing director, 155 East 44th St., New York, N. Y.

Wisconsin Utilities Association—Electrical section, commercial and technical divisions, convention and exhibit. Pfister Hotel, Milwaukee, Wis., November 11-13. A. F. Herwig, executive secretary, 135 West Wells St., Milwaukee, Wis.

Program Completed by Electrochemists

The Electrochemical Society will hold its 72d convention in the Hotel Chase, St. Louis, Mo., October 13-16. Arrangements have been made to visit the plants of the Monsanto Chemical Company and the Wagner Electric Corporation.

A series of exhibits of scientific and industrial products will be held in conjunction with the convention.

The opening session will be devoted to automatic electrochemical control of chemical manufacturing processes, with G. A. Perley, Leeds & Northrup Company, presiding. The second session, under the chairmanship of J. W. Marden, Westinghouse Lamp Company, will discuss the new static devices for furnishing direct current for electrochemical processes.

There will be a session of Electrothermics and Electro-organics, presided over by William G. Harvey, Aluminum Company of America, president of the society. The outstanding event is the Friday evening dinner, at which Dr. Frederick Mark Becket, Electro-Metallurgical Corporation, will receive the Acheson medal and a $1,000 prize for his outstanding contributions to electrothermics.

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Porcelain Institute Forum

Announcement has been made that the seventh annual meeting of the Porcelain Enamel Institute will be held in Chicago October 11–12 and the second Porcelain Enamel Institute Forum will be conducted at Ohio State University, Columbus, Ohio, October 13–15. There will be speakers from both within and without the industry who will present subjects of general interest to the membership.

•

Ross to Resign From SEC

Reports that J. D. Ross was to resign as a member of the Securities and Exchange Commission were confirmed last week by the Presidential party at Seattle. Mr. Ross, superintendent of the Lighting Department of Seattle, has been often mentioned as likely to be named by Mr. Roosevelt as administrator of Bonneville power project. Jerome Frank, New Deal attorney, has been mentioned as possible successor to Mr. Ross.

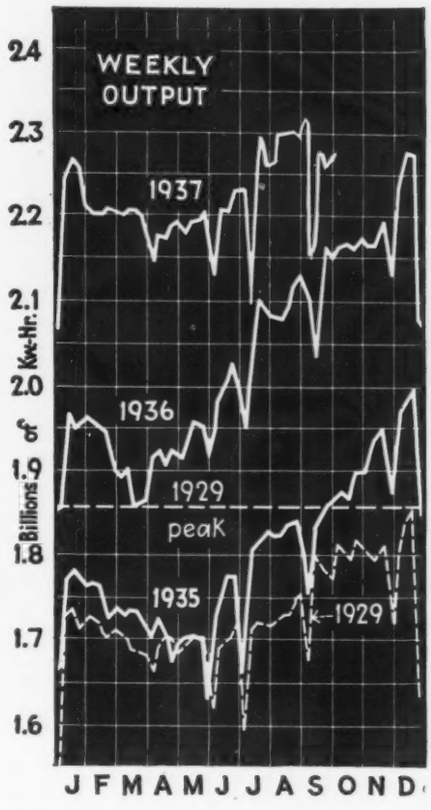
Mild Upturn in Output

Lead over 1936 advances to 5.5 per cent—Production remains under summer average

Matching last year's pattern for the same period, the output of energy by the electric power and light industry during the past three weeks has held approximately level with only minor fluctuations. During the week ended October 2 it amounted to 2,275,742,000 kw.-hr., according to the Edison Electric Institute. This was slightly more than in the preceding week and 5.5 per cent above the figure for the corresponding week a year ago, against the previous 4.4 per cent.

Unlike 1936, operations since Labor Day have been below the midsummer average, whereas normally a rise is to be expected. The figures indicate a slackening in industrial activity, especially in New England, where energy production during the past month has shown only a narrow margin over last year.

Fair gains continue in the Central industrial region, now 7.7 per cent above 1936. The high spot is still in the Mountain States.



Weekly Output, Millions of Kw.-Hr.

1937	1936	1935
Oct. 2...2,276	Sept. 26..2,157	Sept. 28..1,857
Sept. 25...2,266	Sept. 19..2,171	Sept. 21..1,852
Sept. 18...2,281	Sept. 12..2,029	Sept. 14..1,828
Sept. 11...2,154	Sept. 5..2,099	Sept. 7..1,752
Sept. 4...2,321	Aug. 29..2,136	Aug. 31..1,810
Aug. 28...2,295	Aug. 22..2,126	Aug. 24..1,840
Aug. 21...2,304	Aug. 15..2,094	Aug. 17..1,833

Per Cent Change from Previous Year

Region	Week Ending Oct. 2	Sept. 25	Sept. 18
New England	+ 0.7	+ 1.8	+ 0.6
Middle Atlantic	+ 3.6	- 3.0	+ 3.9
Central Industrial	+ 7.7	+ 7.3	+ 6.5
West Central	+ 5.5	+ 4.3	+ 0.2
Southern States	+ 6.2	+ 4.4	+ 3.7
Rocky Mountain	+13.0	+13.4	+16.5
Pacific	+ 4.9	+ 4.1	+ 8.9
United States	+ 5.5	+ 4.4	+ 5.1

Output Sets New High in Year Ended Aug. 1

Production of electricity for public use in the United States amounted to 118,499,000 kw.-hr. for the year ended August 31, making a new high record, according to the Federal Power Commission.

Considerable increases have been reported every month this year over the corresponding months in 1936, as follows:

	Millions of Kw.-Hr. 1936	1937	Per Cent Increase*
January	9,247	9,850	12.6
February	8,691	8,965	11.7
March	8,906	9,923	17.5
April	8,893	9,595	13.7
May	9,088	9,719	12.6
June	9,160	9,818	12.4
July	9,682	10,084	9.0
August	9,814	10,334	10.0

*On comparable basis, adjusted for changes in classification beginning with 1937.

Average daily production in August was 333,356,000 kw.-hr., 2.3 per cent greater than that for July. Production by water power in August was 31 per cent of the total, the same as for August last year, the commission reports.

Total stocks of coal held by electric utility power plants on September 1, 1937, amounted to 9,845,927 net tons, an increase of 0.2 per cent over stocks on August 1, 1937, and of 43.8 per cent over September 1, 1936.

Electric utility power plants consumed 4,191,922 net tons of coal in August. Of this amount, 4,031,746 tons were bituminous and 160,176 tons were anthracite, increases of 4.8 and 2.8 per cent, respectively, as against the preceding month.

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Cities Service Suit Dropped

An $18,000,000 accounting suit directed chiefly against the Cities Service Company and its president, Henry L. Doherty, was ordered marked off the calendar last week by Supreme Court Justice Charles B. McLaughlin. Attorneys for the plaintiff, Morton Marks, suing as a stockholder, and for the defendants, failed to answer the clerk's call for trial of the suit.

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Test Specifications for Glass Insulators Released

Recently circulated by A.S.T.M. are tentative methods of testing pin-type lime-glass insulators for primary and secondary power circuits. The routine tests cover the detection of structural defects, thread quality, resistance to thermal shock and the determination of mechanical strength.

As circulated for study, the electrical test paragraph is amplified by two appendices which cite the E.E.I. transmission and distribution committee's specification for insulator threads and gauges and the A.I.E.E. standards for flashover and dielectric strength tests. Suggestions for revision of the tentative draft are welcomed at A.S.T.M.

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Georgia Power Begins New Mazda, I.E.S. Sales Drive

In a "light conditioning" campaign to run from October 4 through November 22, Georgia Power Company plans to sell, through its employees and 1,450 co-operating dealers, some 25,000 cartons of Mazda lamps and 6,000 I.E.S. lamps.

On each sale of either carton of lamps featured in the campaign, or on sale of six bulbs at full list price, the company will give an I.E.S. lamp certificate good for $1 on the purchase of any I.E.S. lamp from company or co-operating dealer.

•

Utilities to Build New Lines

Wisconsin Public Service Corporation has been authorized by the state Public Service Commission to construct rural electric lines in the towns of Liberty and Newton, Manitowoc County; Franklin and Carlton, Kewaunee County, and Pine River, Lincoln County. Wisconsin Power & Light Company has been authorized to extend lines in the town of Linden, Iowa County, and the Mississippi Valley Public Service Company has been permitted to build lines in Buffalo County.

Utility Stocks Sink Lower

Utility stocks moved lower during the past week, reflecting the pressure of a generally lower market, affected, perhaps, by a war scare on Tuesday last. ELECTRICAL WORLD index, 29.3; preceding week, 29.7; corresponding week a year ago, 39.2; 1937 high, 41.5

Dividend Payments Declared on Arrears

Several utility companies have recently taken action on preferred issues against arrears:

California-Oregon Power Company has declared dividends of $1.50 each on both classes of 6 per cent preferred stock and $1.75 a share on the 7 per cent preferred, all on account of accumulations. On July 15 similar amounts were paid against arrears.

Central Power & Light Company, $1.75 a share on the 7 per cent cumulative preferred stock and $1.50 a share on the 6 per cent cumulative preferred, both in arrears.

Texas Hydro-Electric Corporation, 25-cent dividend against arrears on the preferred stock. On July 21 a similar distribution was made on account of accumulations.

Utilities File Issues of Bonds With SEC

Registration statements for two large utility security issues were filed with the Securities and Exchange Commission last week, indicating a revival of the capital market. Consolidated Edison Company of New York, Inc., filed registration statement covering $80,000,000 of securities, Appalachian Electric Power Company, subsidiary of American Gas & Electric, filed a statement covering $57,000,000 of first mortgage bonds and $10,000,000 of debentures and St. Joseph Railway, Light, Heat & Power Company filed for $8,000,000 of securities. The Consolidated Edison statement covered $40,000,000 of 15-year debentures, series due October 1, 1952, and $40,000,000 of 25-year debentures, series due October 1, 1962.

The utility plans to use $60,000,000 of the proceeds of the debentures to redeem on December 1, at 105 and accrued interest, a like amount of Consolidated Gas Company of New York 20-year 4½ per cent gold debentures, due June 1, 1951. The premium and accrued interest will be obtained from the company's cash resources.

Appalachian Electric Power proposes a $57,000,000 first mortgage 3¾ per cent bond issue due in 1967 and $10,000,000 of sinking fund debentures, 4 per cent series, due in 1952.

The company stated that it had contracted to sell all of the outstanding securities of its present subsidiaries, the Kentucky and West Virginia Power Company, Inc., and Kingsport Utilities, Inc., to American Gas & Electric, and that this sale would be made prior to or concurrently with the issue of the securities being registered.

St. Joseph Railway, Light, Heat & Power proposes $6,000,000 of first mortgage bonds, due 1947, and $2,000,000 of 3 to 4 per cent serial notes, due October 15, 1938, to October 15, 1947. The company has contracted to sell privately $1,400,000 of serial notes due 1943-47 to an affiliate and to sell 3,000 shares of $100 par 5 per cent cumulative preferred shares held in the treasury to Cities Service Power & Light, a parent.

Earnings Reports (Utilities)

	Net Income 1937	1936
‡ Comm. Edison and subs.	$9,443,066	$6,264,352
* Cons. G.E.L.&P. Balti..	6,570,030	6,499,443
* Kansas City Pwr. & Lt.	4,588,186	4,408,225
*Comm. & South. and subs.	15,820,054	11,312,251
* Amer. Pwr. & Lt. and subs.	11,559,193	9,833,104
† Standard G. & E. and subs.	4,717,362	3,662,974
† Elec. P. & L. and subs.	9,458,267	6,131,525
† United Gas Corp. and subs.	11,438,261	9,160,602
* Penn. Power & Lt.	8,082,382	8,063,623
* The Montana Pwr. and subs.	3,934,261	2,851,893
* Utah Pwr. & Lt. and subs.	1,703,604	1,047,996
* Oklahoma G. & E.	2,679,120	2,200,963

* Twelve months ended August 31.
† Twelve months ended July 31.
‡ Eight months ended August 31.

New Bond Offerings Totaled $11,500,000 in September

New offerings of electric light and power securities during the month of September totaled $11,500,000, as compared with $32,356,000 in August, and $116,800,000 in September, 1936. Only two companies ventured into the market.

September brought the nine-month period to a close with a total of $549,343,394, compared with $961,635,463 for the similar period of 1936.

New Issues of Electric Light and Power Securities in September

Name of Company	Amount (Par Value)	Offered to	Period	Class	Purpose	Interest Rate	Price	Per Cent Yield
Rochester Gas & Electric Corp.	$3,000,000	Public	30	General mortgage bonds..	Construction and improvements.....	3¼	102¼	3.60
Ohio Edison Co.....	8,500,000	Public	30	First mortgage bonds....	To reimburse treasury for property additions.....	4	100¼	3.97
Total.....	$11,500,000							

ON WITH THE NEW

OFF with the old door and on with the new reclosing door—it's easy to convert your G-E 50-ampere enclosed indicating fuse cutouts to reclosers without interrupting service. Just:

1. **Shunt the cutout with a jumper**
2. **Unhook the old door**
3. **And put on the new reclosing door**

Then remove the jumper, and the cutout is ready to restore service. Should a fault occur, a second fuse link is automatically connected in the circuit one second after the first fuse link blows.

HOW YOU SAVE

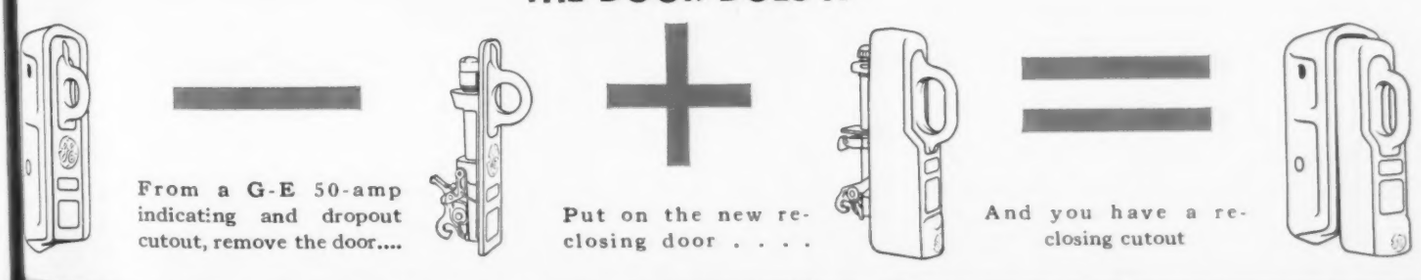
You can save money by converting your present G-E cutouts where you desire the reclosing feature. Or, if you wish, you can obtain a complete new cutout with the same reclosing door—50-ampere ratings at 5000 volts and 7500/12,500 gr-Y volts. In either case the cutout pays for itself the first time it recloses a circuit, because:

(a) You save the cost of one special trip by the service truck, and

(b) You gain the revenue that would otherwise be lost during the service outage.

Ask for Bulletin GEA-2707. General Electric, Schenectady, N. Y.

THE DOOR DOES IT



From a G-E 50-amp indicating and dropout cutout, remove the door....

Put on the new reclosing door . . . .

And you have a reclosing cutout

340-33

GENERAL ELECTRIC

Field OPERATING PRACTICES

New ideas and practices in the operation of well-designed, constructed and maintained plants and systems

Fast Switching in Remote Location

By EDWIN H. SCHLUETER
Chief Line Operator
Rochester Gas & Electric Corp.

Station WHAM in Victor, N. Y., is served by a 33-kv. loop to which the company was desirous of maintaining uninterrupted service at all times. The radio station, however, was located on top of a hill at a distant point which would necessitate some time on the part of our employees if it became necessary to operate sectionalizing switches.

To meet this situation of providing practically uninterrupted service at all times to this radio station and still perform switching operations in a minimum of time, a panel was installed in the radio station for remote control of the two sectionalizing switches. This switching equipment is purely mechanically operated by motors through the panel shown in Fig. 1, with no overload or voltage release protection.

In case of trouble, or of a switching operation, the supervising operator of the company advises the organization of station WHAM and authorizes the operator of the station to insert a handle in the panelboard receptacle to trip one or the other of the switches as directed by our company. The d.c. voltmeter indicates the voltage in the battery used for the motor-operating switch and the four signal lights indicate the positions of the two switches. In Fig. 2 is shown the motor-operated switch and for the protection of the operators the cartridge fuse must be removed before working on the line and a snap switch must be tripped to off position. The detachable handle used on the panel normally hangs at the end of the chain away from the board, so that visitors to the studio will not inadvertently open or close the sectionalizing switches.

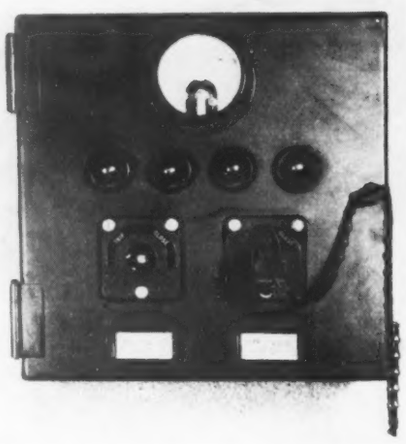


Fig. 1—Panelboard at station WHAM, Victor, N. Y., through which radio station performs switching operations as authorized by Rochester Gas & Electric Corporation

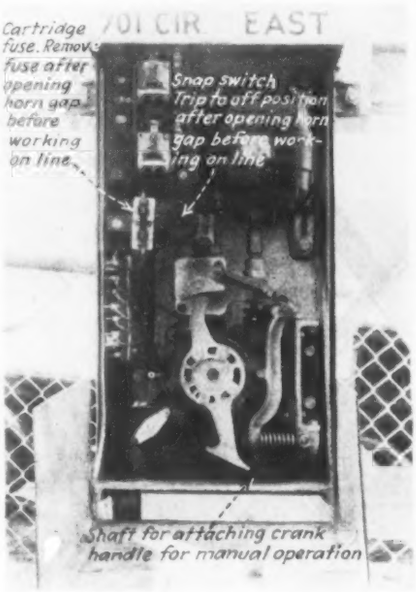

Cartridge fuse. Remove fuse after opening horn gap before working on line.
Snap switch. Trip to off position after opening horn gap before working on line
Shaft for attaching crank handle for manual operation

Fig. 2—Motor-operated remote control for 33-kv. horn gap switches at Station WHAM

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Hints on Methods of Primary Regulation

By H. C. EISLER
District Superintendent, Kansas Electric Power Company, Emporia, Kan.*

Since reactance is a much larger factor in distribution primary regulation than resistance, increasing the number of circuits served from a substation to decrease the load on an overload feeder is generally preferable to increasing the conductor size. The division of a circuit into two or more circuits will result in the regulation being reduced in proportion to the change in load current. In some cases the installation of a through circuit to pick up the load on the far half of a long circuit in which the load is being served over an extended length will result in satisfactory regulation for the present. As the load increases in the future other methods of correction can be readily applied to take care of the regulation.

Voltage regulators, either induction or step type, are, of course, considered. Compensation for line drop may be adjusted for a constant voltage at an arbitrarily chosen load center, or for a maximum voltage on the customer nearest to the regulator during peak loads. The latter method will generally result in improving the voltage near the end of the circuit from 2 per cent to 5 per cent, but requires changing of

* From paper to Missouri Valley Electric Association.

YOUR REPUTATION MAKES THIS POSSIBLE

EACH NEW APPLIANCE that goes into the homes on your system is a tribute to a service record that few other industries can equal—a tribute to your reputation for service continuity. Yes, continuity of the power supply is taken for granted by each customer who adds to the home comforts and necessities that are largely dependent on your service. To help you safeguard this reputation, General Electric offers a distribution transformer whose excellence in the past has helped build the industry's record—a transformer whose continued reliability is assured by constant attention to Perfection of Detail. General Electric, Schenectady, N. Y.

GENERAL ELECTRIC

300-55

compensation with changes in the peak load to prevent excessive voltage. Low voltage near the ends of circuits which are heavily loaded or exceedingly long may be improved by changing the transformer tap settings, installing an additional circuit with regulators, or installing regulators in the line. Changing the tap settings of the distribution transformers to increase the secondary voltage can be done without having excessive voltage during the lightly loaded condition as the reactive drop is generally high at that time.

Rural lines are generally long, lightly loaded, and the revenue from such lines limits the expenditure for voltage-regulating equipment to as low a figure as possible. The installation of an automatic booster increasing the voltage 5 per cent or 10 per cent as the load increases and co-ordinated with the tap settings of the distribution transformers distributed along the line will materially improve the voltage conditions.

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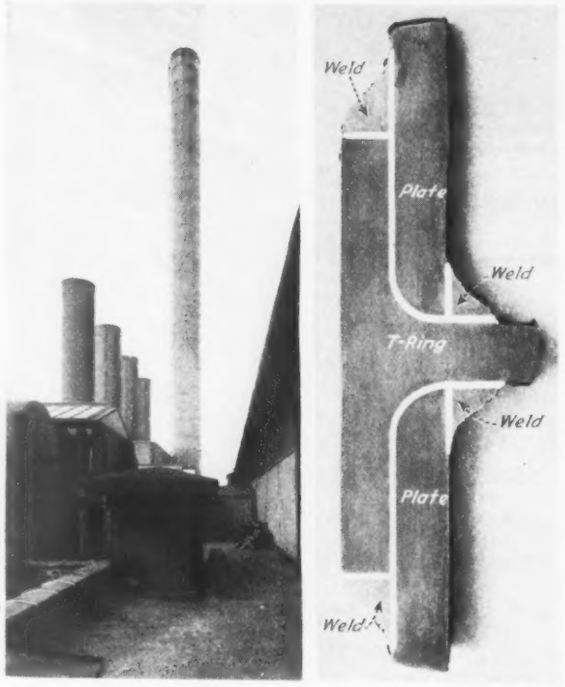
Welded Stack at Fisk Station



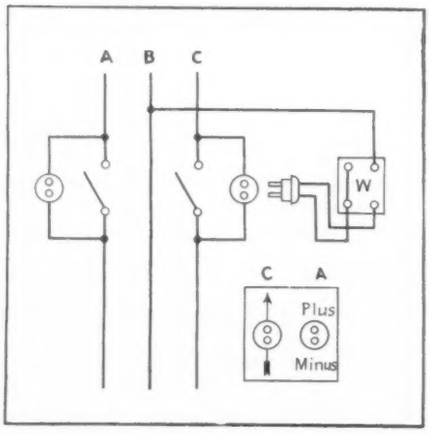
Believed the largest of its kind, the arc-welded steel stack recently completed at the Fisk station of the Commonwealth Edison Company rises 220 ft. above the roof of the station, 300 ft. above Chicago datum. The stack is 13 ft. 10 in. inside diameter and is built of $\frac{5}{8}$-in., $\frac{1}{2}$-in. and $\frac{3}{8}$-in. steel plate.

Vertical joints are butt welded. Horizontal joints are made with a T-ring in three sections as shown in the detail. Each section was welded in the shop at the top of a corresponding plate. When the section was hoisted into place the "T" occurred at the top, so all welding was downhand. The stack thus was built up of a series of prefabricated 120 deg. sections and the only field welding necessary was the joining of the bottom edge of each section with the T-ring at the top of the one below and the vertical butt welding of the plate sections. It is believed that the welded construction will markedly reduce maintenance cost, since the possibility of corrosion at joints is practically eliminated.

One Meter Can Serve for 3-Phase Power

By C. W. STUBBINGS
Winchester, England

Power in a balanced or unbalanced three-phase load of moderate value may be measured by means of a single wattmeter. It will be seen that the current coil of the wattmeter in the accompanying workshop arrangement can be made to carry either the A or the C line current at will by means of plug and socket connections which are normally short circuited by knife switches. Voltage circuit connections of the wattmeter are automatically changed over to suit the current connections. The two sockets are best assembled on a small panel and these sockets and the wattmeter plug marked as shown. The socket corresponding to the leading phase is marked with an arrow, so that when this arrow is in register with that marked on the plug the wattmeter connections should give forward reading. The lagging phase plug is marked so that the arrow on the wattmeter plug will indicate "Plus" or "Minus" according as the direction of the current is the same as or opposite to that given by the leading phase plug arrow.



Plug and socket arrangement permits three-phase power measurement with one wattmeter

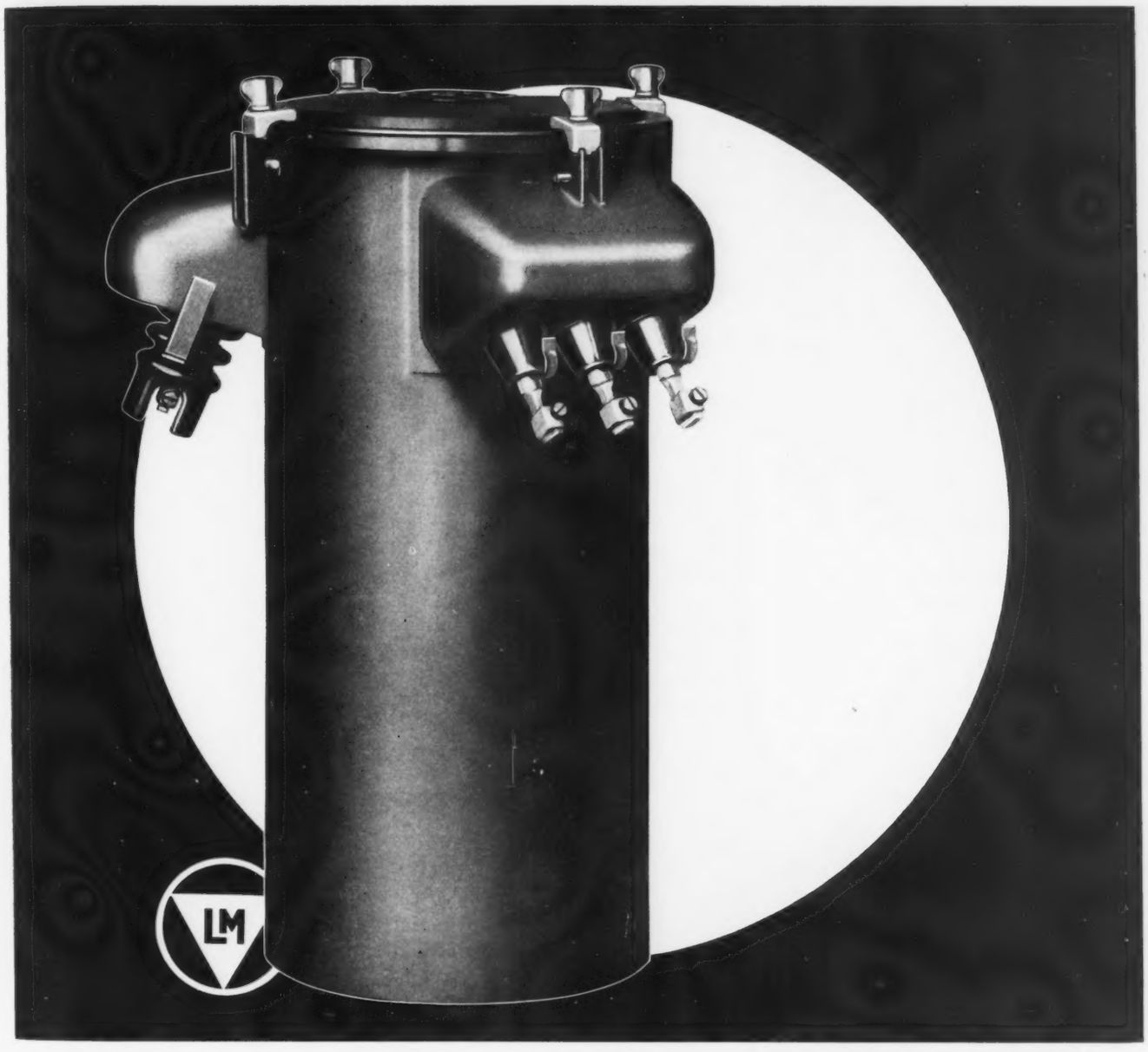
Procedure for testing is quite simple. The plug is first inserted in the leading phase socket with the arrows in register and the connections to the wattmeter terminals are so adjusted that, when the switch is opened, the reading is forward. The plug is then inserted in the lagging phase socket in such a way as to obtain a second forward reading. If the power factor is over 0.5, the arrow on the plug will point to "Plus," showing that the two readings are to be added to obtain the total power. If the power factor is under 0.5 the plug will have been reversed and the arrow will point to "Minus," showing that the second reading has to be subtracted from the first.

•

Welding Cures Wear on Pulverizer Shafts

Probably nowhere in power plant maintenance work is there a greater demand for an economical means of repairing worn machine parts than around coal mill pulverizers. The severe service of such equipment soon wears away the metal surfaces. A method of repair of such parts which has been found simple, efficient and economical is electric welding. This process saves power plants thousands of dollars per year.

Coal pulverizer mill journal shafts rebuilt by electric welding are shown in the accompanying picture. These shafts cost $60 each and due to the severe service must be repaired frequently. The surface becomes pitted by coal dust. In making welded re-



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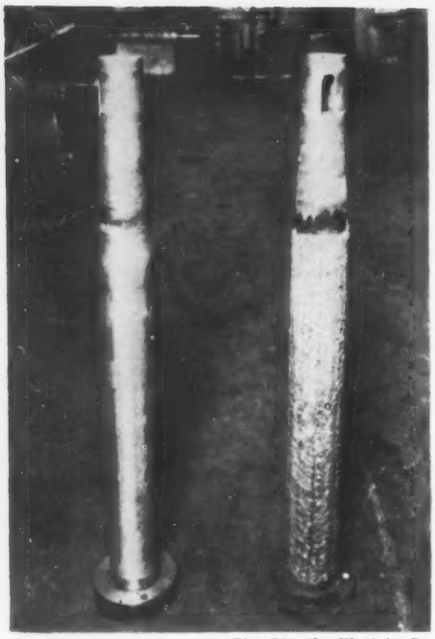
LINE MATERIAL CO.



The Lincoln Electric Co.

Pulverizer shafts rebuilt by arc welding

pairs, the shafts were machined 1/32 inch off radius to remove the worn spots. The particular shafts illustrated are 3 15/16 inches in diameter. After machining out the worn spots, the shafts were placed in a turning jig and built up by application of weld metal. The entire job required only five hours and the shafts are said to be as good as new when repaired in this manner.

•

Recording and Using Line Troubles Data

By P. N. KENT
Kansas City Power & Light Company, Kansas City, Mo.*

Forms used by the overhead systems department of the Kansas City Power & Light Company for record of troubles data previously stated are quite simple, as may be seen from the two samples here given. We realize that there will be differences of opinion as to the values of the data recorded, and that various companies would add to or subtract from the different items. However, the forms as used have proved very satisfactory to our company and much valuable information has been obtained from them relative to reliability and operating records of various circuits and materials.

* Third installment of a series from paper to Missouri Valley Electric Association.

•

Breakers Simplify Service Equipment

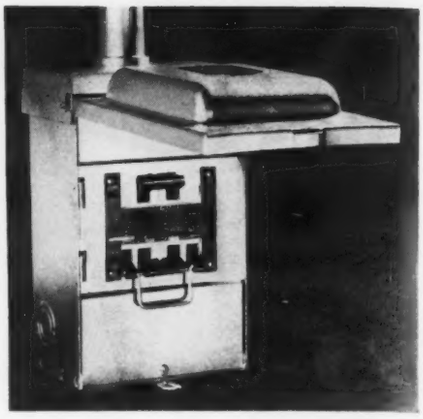
Simplification and standardization of service-entrance facilities has long been the goal of Southern California Edison Company, Ltd. In 1935 this company installed 2,500 units with four externally operated knife switches, a 100-amp. main switch, 60-amp. range switch, 60-amp. lighting switch and 30-amp. water heater switch. Less than a year later these were supplanted by 6,000 improved pull-out switch type units whose dead-front construction concealed live parts. Now the company has put into use 54 of the new multi-breaker units in an attempt to devise standard customer service equipment that would be compact, sightly and flexible.

"Standardization was the basis of our adopting the unit," H. C. Rice, Edison merchandise manager, said. "The company lets the wiring contract and supplies this service equipment to the contractor, thus making certain that service requirements are met at all times. This unit is especially adaptable to our plan of sequence metering."

The new equipment was designed to control range and water heater circuits as well as to protect the lighting distribution panel. Construction is sealed and weatherproof. The unit is equipped with screw-type fitting on top for service conduit, knock-outs on sides and bottom for load conduits. Included in the housing are a 50-amp. range switch, 35-amp. lighting switch and 25-amp. water heater switch. All settings correspond to wire size ratings. Main body is hinged to the side of the housing so that it may be swung out of the way while wires are being drawn through connecting conduit, swung back in place for connection.

Size of unit is about one-third that of those in general use. The company's units in 1935 measured 17½ x 21¼ in. Today's measurements are 6½ x 9.

"Appearance was a primary reason for this," Mr. Rice explained. "In a large majority of instances new range and water heater wiring goes into an existing dwelling. This means that installation is made on the exterior of the house. The new unit is compact, has no protruding parts and generally is trim in appearance as compared to the large units and unwieldy combination of switches required in the past."



Close-up of new multi-breaker unit for service entrance

Multi-breaker unit installed on the exterior of a house

In the past such units were awkward and unsightly; new equipment, however, is compact and weatherproof.

STANDARD FORM FOR DAILY RECORD OF CIRCUIT OUTAGES

Date	Time Out From	To	Hr.	Min.	Where Line Relayed	Cause and Remarks
	Circuit No. 1-3305					
2/15/37	10:47 AM	10:53 AM	0	6	Locked out at Sub 3	Wire floating from insulator at pole 4665

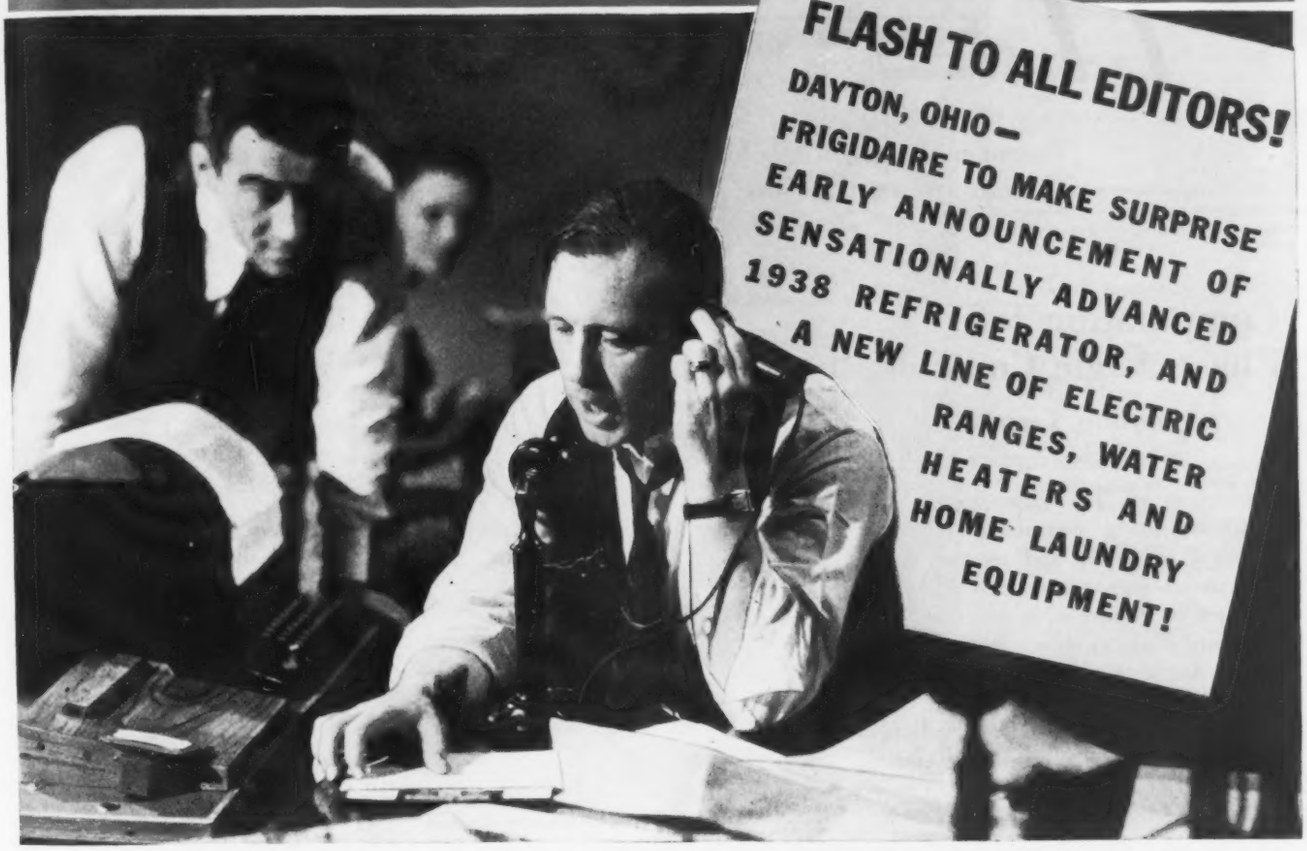
STANDARD FORM FOR DAILY RECORD OF MATERIAL TROUBLES

Line Insulator Troubles - 33,000 Volt System

Date	Circuit No.	Pole No.	Phase	Outage	Make & Rating	Cause and Remarks
2/4/37	1-3305	547	A	No	XYZ 15 KV Pin	Broken by shot

Forms for record of line trouble

HOLD EVERYTHING!


FLASH TO ALL EDITORS!
DAYTON, OHIO—
FRIGIDAIRE TO MAKE SURPRISE EARLY ANNOUNCEMENT OF SENSATIONALLY ADVANCED 1938 REFRIGERATOR, AND A NEW LINE OF ELECTRIC RANGES, WATER HEATERS AND HOME LAUNDRY EQUIPMENT!

FRIGIDAIRE DEALERS TO GET HEAD START TOWARD BIGGER YEAR THAN EVER IN 1938!

● Frigidaire's about to make headline news again! Watch for the first details of the 1938 Frigidaire with sensationally advanced Meter-Miser, and scores of other new sales-clinching advantages! Get the details about the new Frigidaire appliances—ranges, washers, ironers, water heaters—that will give Frigidaire Dealers outstanding products in the major appliance field.

Thus, Frigidaire Dealers are about to get a head start toward a bigger year than ever before! The sales records they shattered in 1936 and 1937 will be smashed anew in 1938! For behind its new 1938 Frigidaire with the Meter-Miser—and behind each of its revolutionary new appliances—Frigidaire will put the same dynamic, compelling sales-strategy that has made Frigidaire the largest-selling refrigerator! And back that strategy up with the heaviest, most concentrated advertising campaign in Frigidaire history!

So HOLD EVERYTHING for next month's big Frigidaire announcement. It's going to be another Frigidaire year—with new and greater selling opportunities in the major appliance field!

FRIGIDAIRE DIVISION
General Motors Sales Corporation
Dayton, Ohio

New ENGINEERING IDEAS

Discoveries, proposals and developments by electrical engineers and scientists in the field, the factory and the laboratory

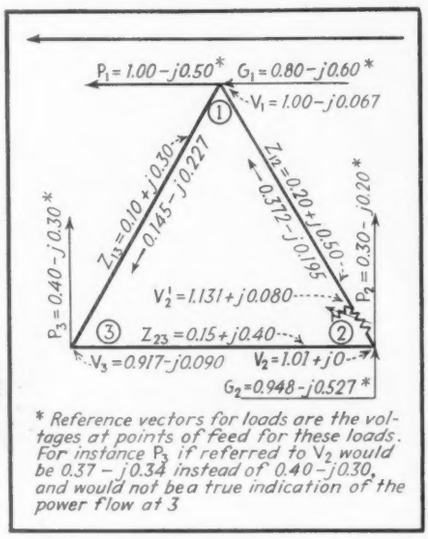
Computation for Phase-Angle Control

By ELWOOD A. CHURCH
Engineering Department,
Boston Edison Company

Selection of the phase-angle and voltage-adjusting equipment to control flow of power and reactive kva. over an interconnection network may be based on results of an a.c. calculating board study as shown in the article "Phase-Angle Control Solves Interconnection Problem," on page 71 in this issue. In that instance computations of the following nature were also made and they are presented as being typical of problems arising increasingly as interconnection points multiply.

A single system composed of two generating stations, G_1 and G_2, with local loads, P_1 and P_2, and a transmission loop to a third load, P_3, is shown in the figure.

Suppose that G_1 is limited to 80,000 kw. at 80 per cent power factor, the capacity of line Z_{23} is 1,250 amp., and that 14,000 and 14,140 volts is maintained by G_1 and G_2, respectively. The problem is to find the voltage at 3 and the phase-angle and voltage correction necessary to accomplish the power and reactive kva. flow established by the conditions set up.



* Reference vectors for loads are the voltages at points of feed for these loads. For instance P_3 if referred to V_2 would be 0.37 − j0.34 instead of 0.40 − j0.30, and would not be a true indication of the power flow at 3

Typical case of interconnector flow calling for regulating transformers

It is simpler to calculate all quantities on a per-unit base. A convenient base for most large systems is 100,000 kva. Nominal potential of the lines or generators is used as a base. This determines the impedance base.

In this problem:

100,000 kva.	= 1.0
14,000 volts	= 1.0
4,120 amperes	= 1.0
1.96 ohms	= 1.0

The quantities shown on the diagram are given on the above base. Only the last step of the cut-and-try process will be shown, which is sufficient to illustrate the method.

It can be seen by inspection that considerable power will flow from 2 to 1, and since the voltage level is nearly the same at 1 and 2, lagging reactive current will flow from 1 to 2, tending to overload G_1. This dictates voltage control in Z_{12}, and since it is immaterial where the phase-angle control is located, both may be located in the same unit. It would be preferable to locate the unit at 2, since the voltage boost inserted will increase the capacity of the line, provided the line insulation is sufficient for the higher potential.

Assume $I_{23} = 0.273 - j0.131 = 0.276 - j0.132$ per unit kva.
Hence:
$I_{23}Z_{23} = (0.273 - j0.131)(0.15 + j0.40) = 0.093 + j0.090$
$V_3 = 1.01 - (0.093 + 0.090) = 0.917 - (j0.090 = 0.92) - 5.60$
Losses in $Z_{23} = (0.273^2 + 0.131^2)(0.15 - j0.40)^* = 0.014 - j0.037$
Hence output from Z_{23}† $= (0.276 - j0.132) - (0.014 - j0.037) = 0.262 - j0.095$
and output from $Z_{13} = (0.400 - j0.30) - (0.262 - j0.095) = 0.138 - j0.205$
and I_{13} at 3 $= (0.138 - j0.205) \div 0.92 = 0.150 - j0.223$
Hence $I_{13}Z_{13} = 0.082 + j0.023$
and $V_1 = 0.999 - j0.067$

The magnitude of V_1 obtained is close enough to 1.00 so that no further trials are necessary to establish the voltage drop around the loop.
Losses in $Z_{13} = 0.007 - j0.022$
Hence output of $Z_{12} = 0.345 - j0.127$
Hence $I_{12}Z_{12} = (0.345 - j0.127)(0.20 + j0.50)$‡ $= 0.132 + j0.147$
Hence potential at sending end of line $= (0.999 - j0.067) + (0.132 + j0.147) = 1.131 + j0.080$
Hence per cent voltage boost required $= 12.1$
and phase-angle control required $= 0.080 \times 57.3 = 4.6^0$
Losses in $Z_{12} = 0.027 - j0.068$
Hence total losses $= 0.048 - j0.127$
Load on $G_2 = 0.948 - j0.527$

* Conjugate of impedance is used to compute losses.

† Subtraction of power and reactive kva. losses from input to Z_{23} to obtain output corrects the phase angle so that this output may be subtracted directly from P_3 to obtain the output from Z_{13} without correcting P_3 for the difference in phase angle of voltage between 2 and 3.

‡ Impedance should include reactance of regulating transformers. This will be a variable quantity, depending upon the position. An average value may be used for preliminary calculations.

Dust Precipitator for Air Conditioners

Electrostatic precipitation has until recently been largely confined to installations where large quantities of dust were to be removed. Such units were too large, too expensive and required too high voltage (30 to 100 kv. d.c.) to be successfully applied to the removal of smoke and dust from air used for ventilation. Furthermore, the amount of ozone and oxides of nitrogen generated made the air unfit for breathing. A new type of electrostatic precipitator has been developed

It's a KEARNEY PRODUCT

YOUR QUESTIONS OUR ANSWERS

Q. Where are these Trip-O-Link Trip-Savers being effectively used?

A. Having switch ratings of 5 Kv and 7.5/12.5 Kv, 25 ampere, this switch is particularly suitable for rural line construction.

Q. Besides being adaptable for use on pole, as well as on crossarm, can this switch be mounted on a transformer?

A. Yes, the Trip-Savers bearing catalog numbers 7403 and 7404 are designed especially for mounting on transformers, the first being the 5 Kv, 25 ampere and the latter a 7.5/12.5 Kv, 25 ampere switch.

Q. Just what is the cause for the sudden popularity of this Trip-O-Link Trip-Saver?

A. It is a low cost switch, it meets N. E. M. A. standards for flashover values and interrupting capacity, field performances show that hundreds are operating without any failures and linemen are favoring it because it may be so easily and conveniently re-fused.

New—LOW COST TRIP-SAVERS

Here's the "two-shot" reclosing type switch that operators everywhere are installing on rural lines to save trips, lower costs, and assure greater continuity of service to rural customers.

It's a compact switch and, as its name implies, is a trip-saver in the true sense of the word, since it automatically closes-in a second fuse after the first one has blown.

According to reports from the field, operating men now use Kearney Trip-O-Link Trip-Savers to protect large individual rural customers, particularly where continuity of service is an important factor, such as in cases of hatcheries and dairy farms.

If you are interested in protection of this sort, where an extra fuse brings back service almost instantaneously, after a lightning surge or similar fault, be sure to investigate the economic possibilities of this switch.

Write for Further Details.

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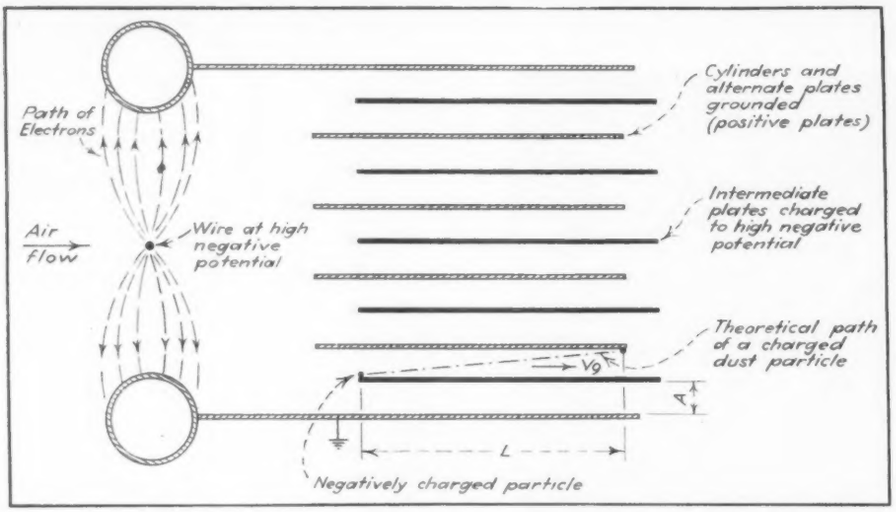


Electrostatic precipitator for ventilation service has separate chambers for ionization and precipitation

Air first passes through the ionizing zone at the left. In this section a fine wire is maintained at a high d.c. potential: this, together with the small wire size, results in an electrostatic stress concentration which is sufficiently high to give ionization by collision and self-maintained discharge so that electrons are liberated and drift toward the grounded rods as gas ions. Any dust particles suspended in the air tend to collect electrons and hold the electrons until the particle touches some conducting surface. As the particles are carried along to the region between the plates the dust particles are attracted toward the grounded electrodes. The dot and dash line shows the theoretical path of the particle, which must travel the maximum distance.

recently which is small, uses lower voltages and lends itself to manufacture in practically automatic units suitable for most air-conditioning applications and in industry where low concentrations of fine dust must be removed.

In the older systems ionization of dust particles and the attraction of the particles out of the air was performed in one chamber. In the new system ionization and separation is performed in separate chambers specially designed to perform these functions.

A high-voltage power unit consisting of transformer, rectifier tubes and condensers supplies 12 to 14 kv. d.c. to the ionizing unit, which consists of parallel grounded cylinders with wires carried on insulated supports spaced between the cylinders. Separation is accomplished by passing the air between parallel plates of a second chamber where a uniformly high electrostatic gradient is maintained and where a dust particle travels only a short distance perpendicular to the air flow before its removal is accomplished. A schematic diagram of the arrangement is shown in the accompanying illustration.

Some dust collects on the grounded cylinders of the ionizing unit. Most of the dust, however, is deposited in the dust collection plate assemblies. Alternate plates of this assembly are grounded, being supported from the case. The remaining intermediate plates are supported by insulated bars and are charged to a lower voltage than the ionizing units.

An electrostatic precipitator of the type described removed approximately a quart of dirt from the air supplied to an experimental laboratory room in $2\frac{1}{2}$ months, although the air had first passed through an air washer. While this precipitator was developed by the Westinghouse Electric & Manufacturing Company primarily for air-conditioning service, there appear to be applications for it in industry where low concentrations of fine dust must be removed from large qantities of air.

Units have also given aid in the treatment of hay fever and asthma.

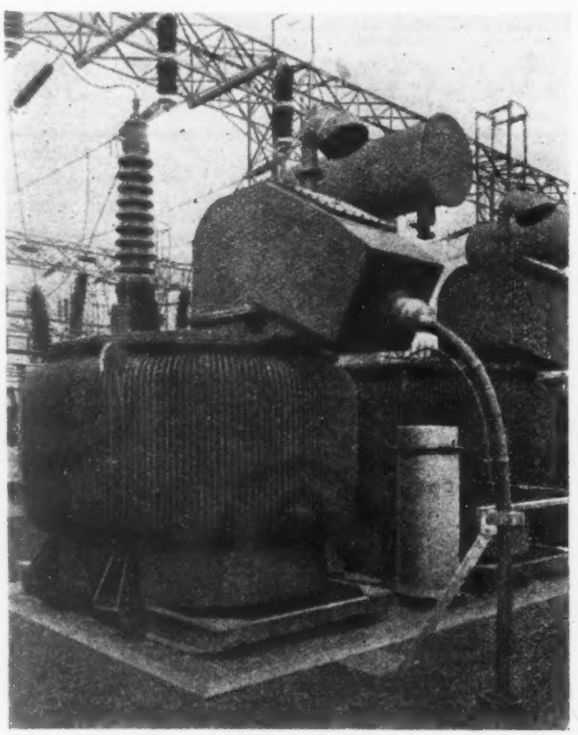
•

132-Kv. Reactors on the British Grid

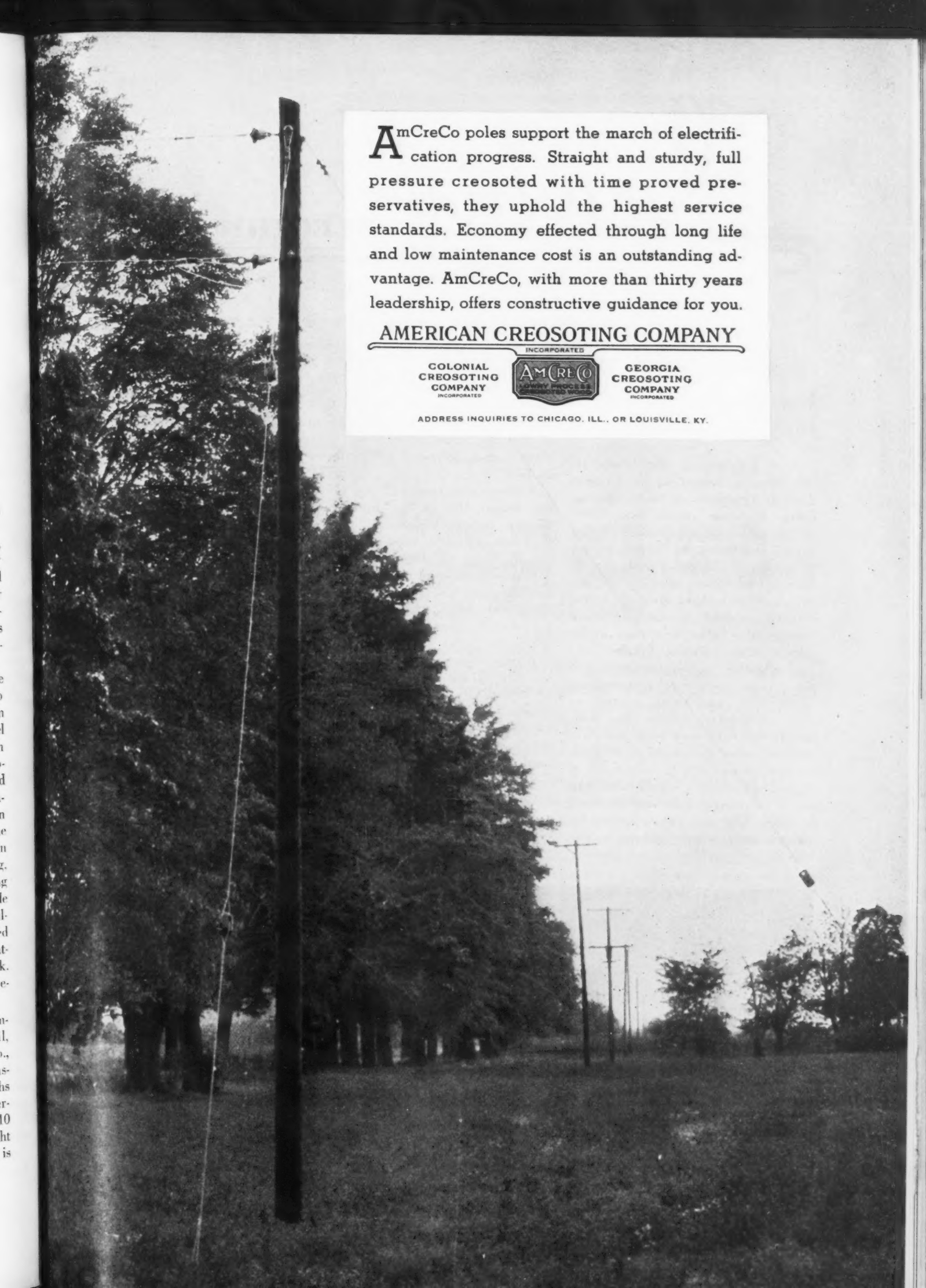
The Northfleet transformer station of the British Grid contains two banks of 132-kv. reactors giving 5 per cent reactance on 50,000 kva. According to *The Engineer* the reactors are oil immersed, the conductors being composed of enameled and paper-wrapped standard cable, the space between conductors, together with the insulation, being sufficient for adequate security against surge conditions. Axial and vertical spacers are made for Fuller board and the coil is formed on a bakelized paper cylinder. The reactors were subjected to a test of 300 kv. between coil and ground.

The tanks are circular and have elliptical radiating surfaces, welded to them. There is an oil expansion vessel with accommodation for a Buchholtz protective device and an explosion diaphragm. Connection to the overhead line is made through an oil-filled bushing, while the outgoing connection is made to a single-core, oil-filled cable finished in a pothead attached to the tank. The loss in one reactor is 20 kw.

Each unit, complete with oil, weighs 38,170 lb., of which the assembled coil weighs 6,500 lb. The overall diameter is 10 ft. and the height over the bushing is 15 ft.



Reactor has oil-filled cable entry



AmCreCo poles support the march of electrification progress. Straight and sturdy, full pressure creosoted with time proved preservatives, they uphold the highest service standards. Economy effected through long life and low maintenance cost is an outstanding advantage. AmCreCo, with more than thirty years leadership, offers constructive guidance for you.

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Use Electric Heating for Airplane Hangar

Need for heating the nearly 8,000,000-cu.ft. hangar of the Douglas Aircraft Company at Santa Monica, Calif., by some means that would occupy no usable space, eliminate fire hazard and fumes, be completely out of reach of employees and provide comfort for those working on the hangar floor without creating drafts, led this company to install electrical heating cable below the surface of the concrete hangar floor.

The heating "cable" consisted of a single resistance-wire heating element, 53,000 ft. in total length, installed in ¾-in. galvanized conduit filled with transil oil. One-inch long porcelain insulator tubes spaced the wire in the conduit. Loops 300 ft. long made of conduit spaced 2 ft. apart were run across the hangar floor and arranged in twelve sections, each controlled by a thermostat. Supply voltage is 460, with 230 volts applied to each element.

This heating load, together with other similar loads in the plant, is controlled by peak-limiting equipment so that the maximum demand of the plant is not increased by virtue of its use.

A temperature rise of 12 deg. F. was the design aim of the installation. During average winter conditions a floor temperature of 80 deg. F. is obtained. However, during the extreme cold periods of the past severe winter in California, and at times when the 275 x 35-ft. hangar doors were opened for extended periods, the floor was noticeably cooler.

It was found that when the heat was first turned on a certain amount of "sweating" of the concrete floor occurred, especially in spots where the ground had been filled and wetted, but this sweating stopped as soon as the earth dried out.

The following advantages are listed for this system of heating:

1. Operates on off-peak power at low rate per kilowatt-hour.
2. No fire hazard or fumes.
3. Easy to install.
4. Maintenance low.
5. Installation cost said to be lower than other heating systems.
6. No usable space occupied.
7. Out of reach of employees.
8. Creates feeling of comfort for those working on floor.
9. No drafts.
10. Concrete and earth under it have considerable heat storing capacity.
11. Materials and tools on floor are kept warm.
12. No special attendance required.
13. Even distribution of heat.

This installation is in the territory served by the Southern California Edison Company, Ltd.

Electric heaters embedded in concrete floor heat 300x300-ft. airplane hangar

•

Use Electric Boiler for Dairy Sterilizing

By CHARLES D. SUBLETTE
Davis, Cal.

Experience with one of the earliest electric boilers to be applied to dairy sterilizing work is perhaps indicative of the operation to be expected from other installations of this type, which are increasing in popularity in urban areas. In February, 1931, a 10-kw. electric boiler of the Wesix type was installed on the dairy of the George Brothers near Sacramento, Cal., for sterilizing the utensils used in this 50 cow dairy. The average monthly energy consumption for this boiler is 350 kw.-hr., or nearly 12 kw.-hr. per day.

Utensils to be sterilized are washed and placed in a galvanized iron sterilizing chamber, which in this instance is 28x36 in. x 5ft. and subjected to steam at a pressure of 15 lb. per sq.in. In preparing the boiler for each sterilizing operation about 12 gal. is placed in it, of which 5 gal. of hot water is later withdrawn to be used in washing. The remaining 7 gal. is raised to 15 lb. pressure. About twenty minutes is required.

How the FUSTAT makes *feasible* a NON-TAMPERABLE FUSE

Resists Tampering — Stops Over-fuseing

A Fustat cannot be replaced by a penny or slug — and it is practically impossible to bridge it with tinfoil, strands of lamp cord or any other material.

Stops use of over-size fuses — a 20 or 30 ampere Fustat will not fit in a 15 ampere receptacle or adapter. Similar limitations apply to all other sizes.

Once you have installed the correct size to protect, your protection cannot be taken from you.

Adapter fits Edison base fuse holders and locks in place.
Retails at 7½c

But that's not enough . . .

A non-tamperable fuse that would blow on starting currents would be an impractical device — a terrible nuisance — so the Fustat . . .

Wipes out any excuse *for* Tampering *because* it won't Blow Needlessly . . . .

A Fustat won't blow when washing machines, refrigerators or other motors start. A 15 ampere Fustat will permit you to load an ordinary circuit to capacity — and yet not blow on motor starting.

It gives you SAFE PROTECTION without USELESS SHUTDOWNS.

Protects flexible cords against burnout — in spite of its long time-lag

The Fustat contains a fuse. The ability of a fuse to protect against dangerous cord shorts or grounded sockets is well known.

The Fustat – HOLDS like a LARGE FUSE when safety permits, *yet,* OPENS like a SMALL FUSE when safety demands

Today's circuits demand the Fustat — *for what other device can . . .*

1. Make safe protection remain safe.
2. Stop loss of money on needless "blown fuse" service calls.
3. Permit adding more appliances to present circuits.

The FUSTAT

Retails at 7½c
15 to 30 amp. sizes

Write for full information to any of the undersigned

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NATIONAL ELEC. PRODUCTS CORP.
Fulton Bldg.,
Pittsburgh, Pa.

Electric Furnace Cuts Enameling Cost

By A. J. G. SMITH
Solihull, Warwickshire, England

Savings in enameling cost per ton of finished ware of 44 reichsmarks per ton are being realized in Germany by the use of electric enameling furnaces to replace gas-fired furnaces. In the enameling works involved a three-chamber furnace is used in the dry process of cast-iron enameling. Each chamber is 2 ft. 7 in. x 2 ft. 7 in. x 1 ft. to spring of arch. Outer ovens are rated at 15 kw., the middle oven is rated at 20 kw. About twenty minutes is required to fire three coats of enamel on cast-iron stove plates at 835 deg. C. It is customary to cool the plates to 400 deg. between firings. With an hourly output of 1,650 lb. consumption is about 590 kw.-hr. per ton of ware. A comparison of the cost of operation of this furnace with the producer gas-fired unit it replaced is given in the accompanying table.

Electric vs. Gas-Fired Enameling Furnaces

	Electric	Producer Gas
Production per day of 22½ hours of finished ware.....lb.	3,168	1,501
Weight of supports.....lb.	.....	61.6
Average weight of charge....lb.	42.24	39.6
Firing time per charge.....min.	4–6	9½
Door opened per day.....hours	4.06	0.30m
Loading, unloading, stoking, etc.....hours		4.40
Number of charges per day..	225	112
Wages of stoker per muffle per day.....R.M.	.....	1.50
Rejects per day.....lb.	.....	26
Fuel consumption per day...kw.-hr.	850	cwt. 13
Cost of installation.....R.M.	7000	9000
†Wages per day.....R.M.	15	31.50
Capital and Upkeep Costs		
Energy as compared with coal costs.....	8,900	2,240
Upkeep and repairs.....	600	3,300
Wages.....	4,500	9,450
Sinking fund and depreciation at 15 per cent.....	1,0.0	1,350
Total.....R.M.	16050	16,340
Production per annum.....tons	430	200
Cost per ton of finished ware..R.M.	37.30	81.70

† Electric furnace, three operators.
Gas furnace, three operators, three helpers and one stoker for several furnaces.
Price of brown coal R.M. 11.50 per ton delivered.
Cost of power: R.Pf. 3.5 per kw.-hr.

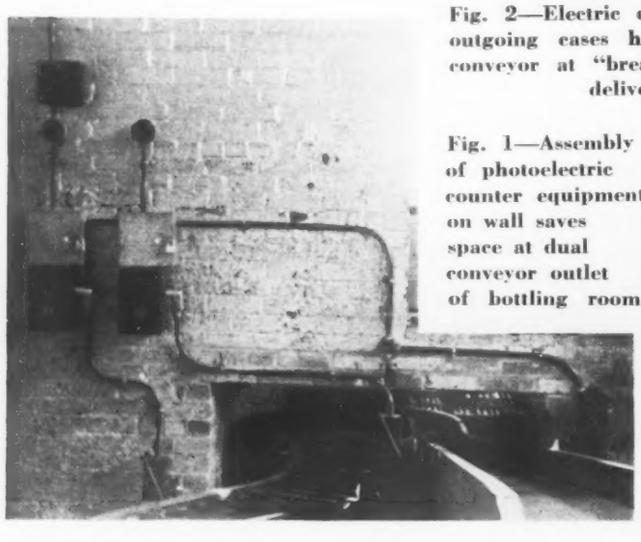

Fig. 1—Assembly of photoelectric counter equipment on wall saves space at dual conveyor outlet of bottling rooms

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Prove Accuracy of Photocell Counters

To check outgoing shipments of beer at the Dawson Brewery, New Bedford, Mass., three installations have been made of photo-electric counters with an additional unit on a return conveyor where empty cases are brought back into the plant. While such counters are widely used in industry, the application at this plant illustrates the flexibility of such service in a marked degree. Thus, Fig. 1 shows the conveyor output of two bottling rooms, running substantially parallel toward the delivery room. The equipment is mounted on the partition wall and wired in rigid conduit, the photo-relay housings and light sources being placed on the sides of the conveyors to catch the outgoing cases in transit. Fuses, control switches and the counter equipment are all mounted compactly against the wall, and the equipment checks the cases in order to give the management a "line" upon losses through breakage and the imbibing of the product by employees and visitors.

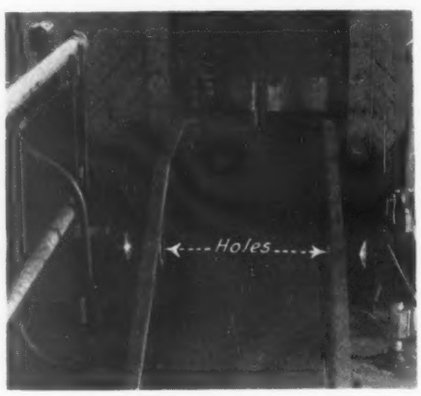

Fig. 2—Electric cells keep "tab" on outgoing cases handled by shipping conveyor at "break" in direction of delivery line

In Fig. 2 the high sides of the shipping conveyor made it necessary to cut holes to pass the light beam, the cell and source being mounted opposite one another as shown. This was done to count not only the wooden box cases but also cardboard cases and stubby bottles.

The counter was located at this particular point because the cases are closely in contact and separate sufficiently to pass light only at the bend in the conveyor belt. The shipper stands near the counter and operates the conveyor motor switch, finding it simple to check the quantity supplied to each truck as it is loaded, with a saving in time resulting from the accuracy of the counter.

The counter on the return conveyor which handles empty cases, Fig. 3, supersedes a mechanical unit. The Dawson organization states that the photelectric equipment is eminently more satisfactory than the mechanical counters formerly used, which were constantly getting out of order or failing to count accurately. The absence of any mechanical finger or lever subject to maladjustment is valuable with the electrical equipment and with the latter counting can be carried on as rapidly as any reasonable production speed requires.

The counting equipment was furnished by the General Control Company, Cambridge, Mass.

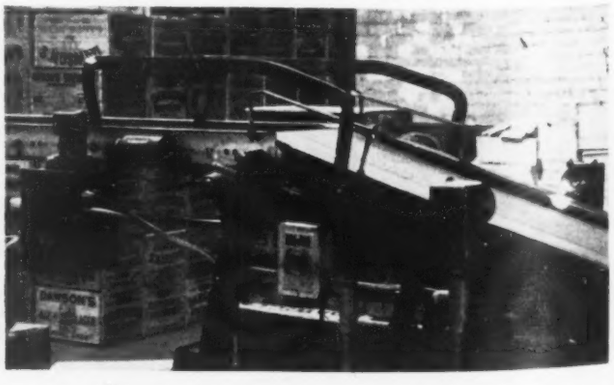

Fig. 3—Return cases are checked up for final auditing of production outgo

VARNISHED CAMBRIC • RUBBER POWER CABLES • BUILDING WIRE • RADIO WIRES • SIGNAL CABLE • FLEXIBLE CORDS • LEAD-ENCASED AND PARKWAY CABLES • ARMORED CABLE

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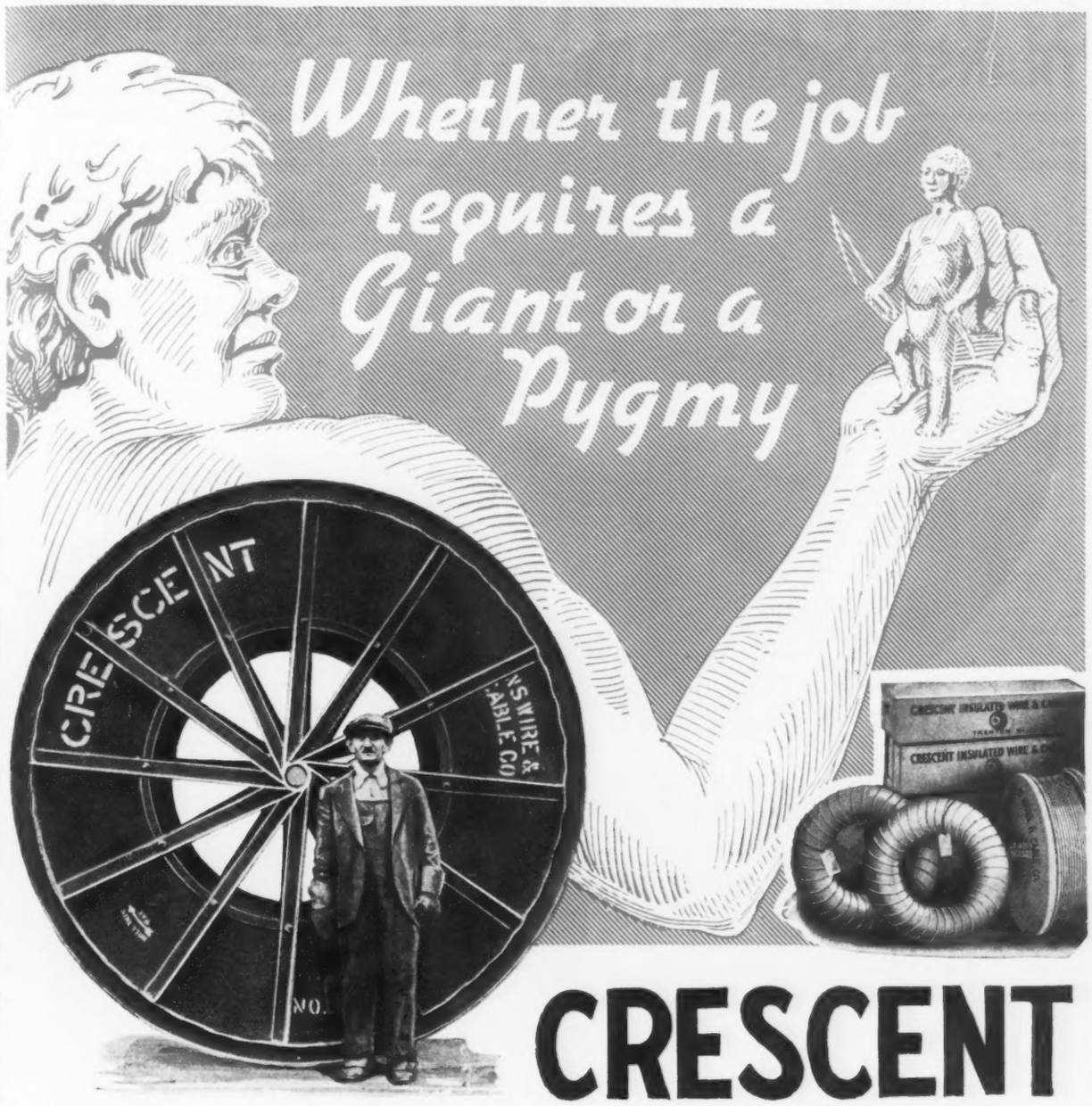

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PARKWAY CABLE

in exceptionally long lengths used to feed power on a New Mississippi River Dam

Whatever the load—power for a mammoth dam or a simple house wiring job—the comprehensive CRESCENT line can furnish you with Wires and Cables exactly suited to your needs.

And Crescent can give you that close, personal type of service which you can expect from only a medium sized, closely knit organization, producing the entire line in one plant, under one management.

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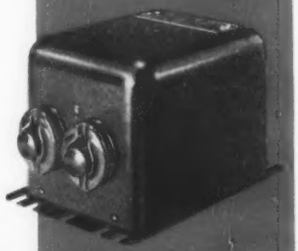
● To provide industry with the many types of transformers required—Jefferson Electric has conducted continually research and experimental work . . . Such work has been done for and with manufacturers of all types of equipment where high voltages are needed—as for radio sending stations, radio receiver sets, public address systems, luminous tube (Neon) lighting, oil burners, mercury lamps, sun ray and street lights, relays, controllers, etc.

The satisfactory performance of products equipped with Jefferson Transformers is the result of the latest design advantages and adept craftsmanship by transformer specialists.

To benefit likewise, tell us just what your requirements are. Our engineers will be glad to cooperate with you. JEFFERSON ELECTRIC COMPANY, Bellwood (Suburb of Chicago) Illinois. Canadian Factory: 535 College Street, Toronto, Ont.

Indoor wall mounting or fixture suspension type Mercury Lamp Transformer.



Typical Oil Burner Ignition Transformer.

JEFFERSON *Transformers*

Separation of Ores by Magnetic Means

Separation, concentration and purification of ores by magnetic means is coming more and more into use. For proper application it is necessary to know the relative magnetic attraction force of various materials. The following table from the *Electrician* furnishes the information for 28 common minerals:

Relative Magnetic Attractive Force of Various Materials (Iron 100)

Apatie	0.21	Lithium	0.5
Argentite	0.27	Magnesium	0.84
Biotite	3.21	Magnetite	40.2
Bornite	0.22	Manganese	8.93
Cerium	15.35	Molybdenite	0.32
Chromium	3.14	Palladium	5.20
Corundum	0.83	Pyrrhoite	6.69
Dolomite	0.22	Quartz	0.37
Fluorite	0.11	Rutile	0.37
Franklinite	35.38	Siderite	1.82
Garnet	0.40	Strontium	3.38
Hematite	1.32	Titanium	1.24
Ilmenite	24.70	Tungsten	0.25
Limonite	0.84	Zircon	1.0

Machines are available for separating a mineral magnetically into several components in one operation.

•

Controlled Heat Improves Ceramics

Close control of temperature through the use of electric heating equipment is an essential in operations of the Ceramic Decorating Company, Huntington Park, Calif. Products of the plant range from cosmetic jars in brilliant and pastel tints to labels on bottles. The containers are painted and lettered with colors of special composition and then placed in the kiln. There they move slowly through a preheating zone into the heating chamber, where the colors are fused directly into the glass. Then they are cooled slowly and come out with a glossy finish that is actually a part of the glass.

Close control of temperature is required in this operation. The glass must become soft and hot enough to fuse with the color, but it must not be too hot, or the container will melt out of shape. This means an allowable variation of only a few degrees at around 1,000 deg. F. This difficult task is performed easily by electric heat which provides an even distribution of heat throughout the heating zone. Electricity's cleanliness is another advantage, since dust or other impurities would ruin the desirable finish.

Advertisement

COPPER ALLOY BULLETIN

Reporting News and Technical Developments of Copper and Copper-Base Alloys

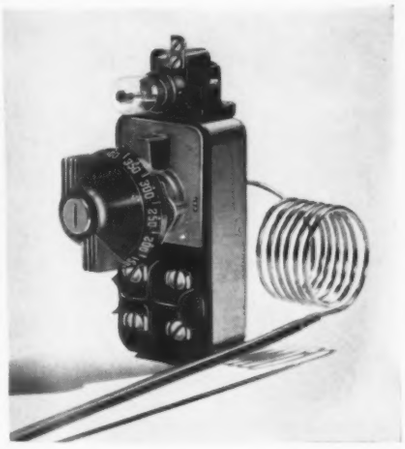
OCTOBER "Bridgeport" BRASS CO. 1937

COPPER TUBING WITHSTANDS SEVERE CONDITIONS IN THERMOSTAT CONTROLS

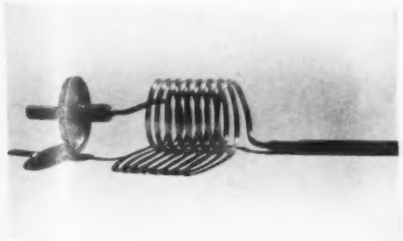
Pure, heavy copper tubing is used for the hydraulic element in the oven thermostat controls manufactured by the American Thermometer Company.

Located within the oven, the hydraulic element, consisting of oven bulb and capillary tube, controls oven temperatures by expansion or contraction of a liquid, which operates a gas valve or electric switch. The hydraulic element is subjected to extremely severe conditions. Oven temperatures fluctuate over a range from room temperatures to 600° F., and pressure within the element approaches 100 pounds per square inch at the higher temperatures. Corrosive oven gases further increase the severity of service. Under these conditions, the hydraulic element must remain tightly sealed throughout the life of the range, which may be 15 or 20 years.

Experience indicates that copper is very well adapted for this exacting service, effectively resisting both the corrosive effects of oven gases and the pressure of the liquid within the element.



Oven thermostat control for electric ranges uses heavy copper tubing for the hydraulic element.



Close-up of the hydraulic element, showing oven bulb and capillary tube, both constructed of pure copper.

AIR-CONDITIONING INDUSTRY INCREASING AS A MAJOR COPPER CONSUMER

Copper and Copper Alloys Provide "Natural" Corrosion-Resistant Material: Demand Up Sharply; Further Expansion Foreseen

As air-conditioning sales so far during 1937 indicate a probable total for the year of $85,000,000, an increase of 60 per cent over the 1936 figures, this comparatively new industry claims the attention of suppliers of raw materials and manufacturers of finished products as an increasingly important market for their goods.

Permanence a Requisite

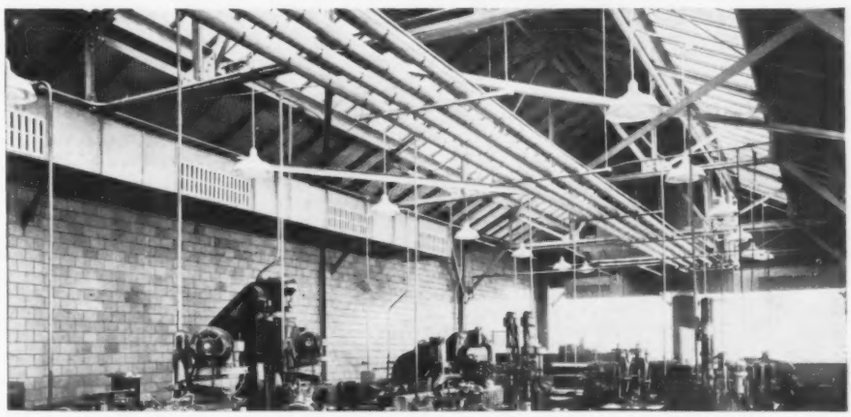
The investment in any permanent air-conditioning system is sufficiently high to require the use of materials which are least likely to deteriorate in use and require expensive servicing or repairs. Here, copper, brass and other corrosion-resistant copper alloys provide the answer to material requirements and find direct use in both the manufacture and installation of tanks, refrigerating lines and miscellaneous equipment used in the air-conditioning system.

For example, copper water tubing and solder type fittings are ideal for coils and connections carrying either water or refrigerants throughout the system. The ready availability of copper tubing in standardized sizes, the convenience in handling and ease with which it may be installed in existing buildings, plus its remarkable resistance to the corrosive action of virtually all chemical refrigerants, combine to make it a product of almost universal acceptance in the commercial air-conditioning field.

Foremost among the special corrosion-resistant copper alloys for fabrication of tanks, pumps, coils, valves, instruments and miscellaneous parts are the Duronze* alloys. Exceptionally strong and highly resistant to corrosion and season cracking, these Bridgeport silicon bronzes have long been used for tank fabrication, special tubing, and in the manufacture of parts for special requirements. They are available from stock in the form of sheet, rod, wire and tube, and may be easily manufactured in special shapes to individual specifications. Their ready weldability and the ease with which they may be fabricated give the manufacturer of air-conditioning a convenient material for construction of strong, permanent corrosion-resistant equipment.

(Continued on following page, Column 2)

*Trade-Mark, Registered U. S. Pat. Off.



The adaptability of copper tubing is illustrated in the air-conditioning system at the Canton, Ohio, plant of Timken Roller Bearing Company. Here Bridgeport's Copper Tubing in sizes up to 4" in diameter and Bridgeport Arco (solder-type) Fittings were used for well water supply and return; chilled water supply and return; condenser piping, the well water and chilled water extended fin coils; condensate return lines from steam coils.

SPECIAL FOUR-PAGE EDITION

A special four-page issue of the COPPER ALLOY BULLETIN containing two additional pages of news and technical data in the form of tables, charts, etc., is issued each month to supplement the copies appearing regularly in this publication.

This four-page edition, conveniently arranged for filing and reference, will be sent to readers requesting to be placed on the mailing list. A note on your letterhead is all that is necessary. Readers already on the mailing list to receive extra copies will automatically receive the special four-page edition.

COPPER ALLOY BULLETIN

NEW DEVELOPMENTS

All items in this column are from sources believed to be reliable. Further information on any of them may be obtained by writing the Bridgeport Brass Company.

A welding current recorder makes it possible to judge the quality of a weld from start to finish by providing a record of the rates of arcing time to total time. Record also shows periods when arc is extinguished and when arc gap is lengthened or shortened. Recorder can be furnished for 110, 220, or 440 volts ac. or 220 volts dc.

A new synthetic liquid suitable for coating plating racks is reported which can be used in copper, nickel, zinc, cadmium, or silver plating at temperatures up to 220° F. It can be applied by brushing, spraying, or dipping.

A new-type tube bending tool is suitable for use on copper or brass tubing in sizes from ⅜ to ¾ inch and wall thicknesses from .020 to .065 inch. Marked positions indicate 45, 90, 135, and 180 degree bends.

A cutting-off machine, for tubing, pipe and solid stock, has automatic stock stop to insure all pieces being cut to accurate dimensions. Stock feed is of the roller type. V-belt drive is used.

Bronze bushings are used in a new V-belt fastener for fabric-core, cross-weave belts. Bushings support an alloy steel rocker pin. Metal does not touch pulleys.

Copper tubing is used on refrigerating fin coils which can be made to order to fit individual specifications. Available in several fin sizes, rising ⅝-inch refrigerant tubing.

New vises have removable jaws recessed for four sizes of pipe or tube from ⅜ to 1 inch. Recesses are lined with a soft alloy that provides a firm grip without scratching or marring the work. Upper jaw is attached to a steel screw operating in a brass bushing.

A new blast heater uses copper and copper alloys in all steam-carrying passages, including headers, tubes, and inlet and outlet bosses. It is reported to be suitable for processing applications as well as for heating and air-conditioning. Headers and tubes are cylindrical and seamless, and are brazed into a single unit, eliminating gaskets and screw joints. Available in a large variety of sizes.

A new spinning lathe is designed for use as an experimental model in the turning out of sheet metal parts. Samples can be readily turned out for comparison purposes until a final design has been arrived at. It is not intended for production work.

A precision testing machine measures the wear resistance, toughness, and adhesive qualities of enamels, lacquers, electroplating, and other finishes applied to a metal base. Readily portable, the machine should find many laboratory uses.

AIR-CONDITIONING GROWTH

(Continued from preceding page, column 3)

Preliminary estimates indicate the air-conditioning industry alone will use approximately 25,000,000 pounds of copper during the current year, compared with 14,000,000 in 1936. In addition, increased demand is anticipated indirectly as a result of this activity. Electrical equipment required to furnish motive power will consume additional quantities of copper in motor windings, control contacts, and wiring connections.

Reflecting the increased use of electrical equipment, increased power demands are anticipated. Steady growth in the use of air-conditioning for domestic purposes will probably at first be noticed by power companies in the form of increased off-peak loads, permitting more efficient use of existing generating capacity. As mass production methods reduce the initial cost of air-conditioning systems, further increases in the number of units in service may lead eventually to the need of additional power capacity.

COLORING COPPER ALLOYS

A new method of coloring the surfaces of copper or copper alloys, recently reported in a foreign technical journal, utilizes water solutions of potassium permanganate, potassium chlorate, and potassium hydroxide as the coloring agents.

The finished color of the surface is controlled by varying the proportions of the solutions used and the time and temperature conditions. The temperatures used in treating the metals vary from 150° to 197° F., and the time of treatment ranges from 5 to 60 minutes. The coloring obtained can be varied from straw-yellow through golden-yellow, dark red, red-brown, and dark brown to deep black.

A spot welder is reported to be capable of making up to 100 spots per minute. Duration of the welding period is regulated by an automatic timer, adjustable to regulate current from 2 to 60 cycles in 110 divisions. Machine is equipped with 8-point hand wheel for heat regulation. Transformer is air-cooled, electrodes and holders are water-cooled.

A wire numbering machine has been developed for use by wire mills and screw manufacturers. Driven by a ¼-horsepower motor, the machine stamps consecutive numbers on the wire. Depending on the number of wheels used, figures up to 999 or 9,999 can be stamped. Machine is said to be especially suitable for stamping wires for test purposes.

BRASS TERMINOLOGY

This is the fifth of a series on the nomenclature peculiar to the industry specializing in the making of brass, bronze and copper alloys. Another article will appear in next month's issue.

Lake Copper is the term used to designate copper which originates in the northern peninsula of Michigan. Lake Copper is available to brass and copper mills in the form of wire bars for rolling down into rod and wire; in the form of cakes for rolling down into sheets; in the form of ingots for melting to make copper billets for the production of tubing, and for melting with zinc to make brass; and to a lesser extent in the form of billets for piercing to make copper tubing.

The nature of the ores found in the northern peninsula of Michigan is such that a reasonably pure copper can be obtained from them without an electrolytic process of refining. Moreover, the silver and gold contents of the Lake ores are not sufficiently high to warrant the electrolytic process to save the gold and silver.

Because Lake Copper is not usually electrolytically refined, it normally contains a small amount of silver (about 0.035%), and frequently a small amount of arsenic. Lake Copper is often specified for special purposes because of its silver content.

Silver-bearing Copper is copper containing more than a minute trace of silver; that is, from about 0.02% to about 0.13%. Sometimes the silver occurs naturally in the copper, as in Lake Copper; sometimes it is intentionally added. The amount of silver present is usually reported in Troy ounces of silver per 2000 lbs. avoirdupois ton of copper.

The presence of this silver is beneficial for some specific purposes, such as the manufacture of copper sheets for 2½-gal. fire extinguishers, for the manufacture of strip for certain automobile radiators, and for some tinned wire.

Arsenical Copper is copper either which naturally contains some arsenic or to which arsenic has been intentionally added. The presence of arsenic increases the life of copper tubes and plates in contact with fire. Arsenical tubing has been used under certain conditions with success instead of brass in heat exchangers, and for condensers using polluted fresh water.

The term "Casting Copper" is applied to a grade of copper that has not been electrolytically refined. Casting Copper is insufficiently pure to be used for electrical purposes or for remelting in a brass mill to make brass or to make copper billets for tubing. It is regularly used in foundries in the manufacture of brass castings.

PRODUCTS OF THE BRIDGEPORT BRASS COMPANY

Executive Offices: BRIDGEPORT, CONN.—Branch Offices and Warehouses in Principal Cities

SHEETS, ROLLS, STRIPS—*Brass, bronze, copper, Duronze,** for stamping, deep drawing, forming and spinning.

CONDENSER, HEAT EXCHANGER, SUGAR TUBES—For steam surface condensers, heat exchangers; oil refineries, and process industries.

PHONO-ELECTRIC* ALLOYS—High-strength bronze trolley, messenger wire and cable.

WELDING ROD—For repairing cast iron and steel, fabricating silicon bronze tanks.

LEDRITE* ROD—For making automatic screw machine products.

COPPER WATER TUBE AND FITTINGS—For plumbing, heating, underground piping.

DURONZE ALLOYS—High-strength silicon bronzes for corrosion-resistant connectors, marine hardware; *hot rolled sheets* for tanks, boilers, heaters, flues, ducts, flashings.

BRASS, BRONZE, DURONZE WIRE—For cap and machine screws, wood screws, rivets, bolts, nuts.

FABRICATING SERVICE DEPT.—Engineering staff, special equipment for making parts or complete items.

BRASS AND COPPER PIPE—"Plumrite"* for plumbing, underground and industrial services.

*Trade-name.

BRASS "Bridgeport" CO.

Established 1865

BRIDGEPORT BRASS

Building Up THE LOAD

New ideas and practices in selling electrical equipment and service to commercial and domestic customers

Installation Costs of Attic Ventilation

By R. M. WINSBOROUGH
Southwestern Gas & Electric Company, Shreveport, La.

Average installation costs on 23 jobs of attic ventilation obtained from a dealer who sells home conditioners in Shreveport are:

Celotex	$9.00
Lumber and other material	8.00
Grille (wire screen)	4.00
Wiring	10.00
Painting	6.00
Labor	20.00
Total	$57.00

This does not include the cost of building louvers in the attic, nor does it include the cost of a second grille if the discharge is taken out over the back porch, frequently the case when porch and house are under the same roof. Considering the case where louvers and second grilles are necessary, this dealer finds that his average installation cost on a 42-in. fan is approximately $100. Thirty-six-inch fans can be installed for approximately $65.

The highest individual wiring cost on any of his jobs was $35, in a case which involved bringing a separate circuit from the garage into the house for the fan, which costs on the average about $16. Where the fan is wired in on an already-existing circuit the cost may be as low as $8.50. Generally it is advisable to wire in a separate circuit so that the fan does not blink the lights too noticeably.

Many of the installations have been sold with time clocks. A Mark-Time switch is generally used, although some other switches have been employed. Installations which do not have time clocks are usually connected with a wall switch in the hall at some convenient point. Some few installations are controlled by a "Levolier" switch or a pull-cord dropped down through the grille in the hallway.

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Prefers Commercial Air Conditioning

By I. LUNDGAARD
Rochester Gas & Electric Company

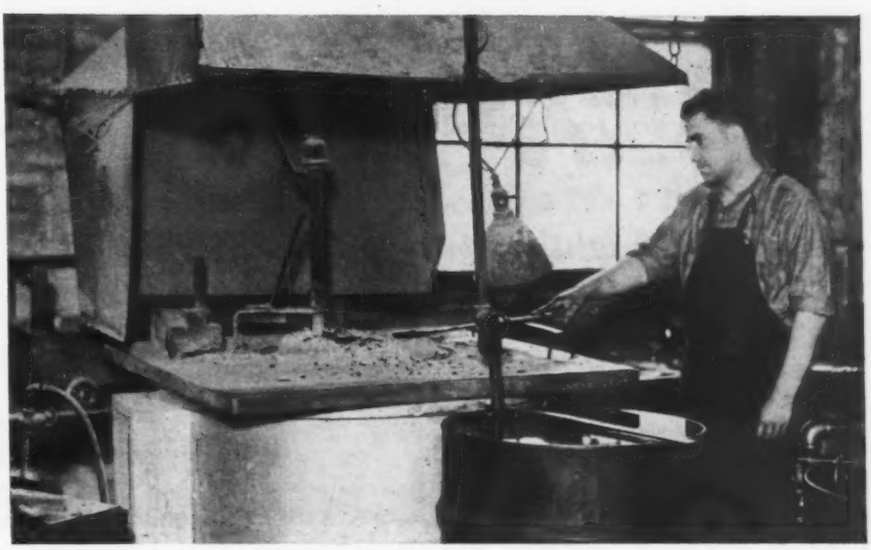
In Rochester we are seeking out commercial air conditioning because it seems to offer better load-building possibilities than other classes of air-conditioning business.

For the first half of this year we had listed 200 kw. of air-conditioning load involving 26 jobs. Last year in twelve months we had 577 kw., involving 46 jobs, connected to our lines in the twelve-month period. This decline in the size of the average installation is not due to any change in policy, but is due to the fact that our market now touches more smaller jobs.

In our commercial promotion of air conditioning we are cognizant of the fact that we can balance our summer commercial air-conditioning load with other loads over the twelve months. On this basis we are looking for more commercial air-conditioning. which we estimate grosses about $18-20 per year.

In our company we face a real prob-

LINE TOOLS MADE BY ELECTRIC HEAT



Quite fitting and proper it is that electricity should be the means of putting strength and dependable quality into the tools the lineman uses. Heat treating is an important step in the manufacture of these tools. The electrically heated lead pots with precision automatic temperature control in the plant of Mathias Klein & Sons, Chicago, insure that the lineman will have dependable tools.

RANGE PROMOTION

THE MODERN HOUSEWIFE TEES OFF!
and twenty miles away a roast is browning in the oven . . . .
When zephyrs blow and sunlit fairways beckon, the modern daughter of Eve drives one far and straight to the flag.
In the starched nineties, womankind's place was in the home because there was so much drudgery to be performed by hand that unless one had loads of money to squander on lackadaisical servants it had to be done by the mistress of the house.
Now life is fashioned to a gayer pattern. Electric equipment, much of it automatic, does things far better, does the work without human effort in less time than it takes to say, "Oh, how tired I am." That's living, when you can make four no trump on the country club porch while the automatic electric range makes dinner (and what a dinner) in your kitchen twenty miles away.
Complete electrification isn't a daydream or an extravagance, it's just garden variety common sense. Are you using the great emancipator for all it is worth?
The Hartford Electric Light Co.
ELECTRICITY IS INEXPENSIVE

No wonder nearly 10,000 electric ranges are in service in Hartford, Conn., and its immediate vicinity and that the average domestic customer, including those not yet cooking by wire, uses 1,107 kw.-hr. per year! Promotional advertising like this is a big help to dealers, who carry the sales load in the electric appliance field with full utility cooperation.

lem with respect to residential air conditioning. For our residential electric business we find a total capital investment of $340 per kilowatt. How much investment per additional kilowatt is going to be necessary for the residential air-conditioning load? Further, all of this business would come on our 1½-cent step and grosses only $12-15 per year. Finally, our standard block layout of transformers and secondaries would have to be altered materially to take care of the redistribution of loads. For these reasons we expect our commercial air-conditioning business will, as it has in the past, grow much faster than our residential air-conditioning load.

Cotton Gin Lighting as a Load Builder

By ALEX LARGENT
West Texas Utilities Company, Abilene

In the territory served by the West Texas Utilities Company are some 322 cotton gins, 136 of which are partially electrified. In determining the requirements for lighting in these gins, we were at once confronted with the problem of high lamp renewal costs, due to vibration. In many gins the bearings are worn, shafts out of line and the entire building and machinery vibrates.

First efforts were directed toward overcoming this vibration, which I did by the simple expedient of suspending all reflectors on springs. This solved the problem, as is proved by the fact that not a single lamp replacement has been made to date where this type of installation has been made.

Before relighting, illumination levels of 1 to 3 ft.-candles are common. Often it is so low as to not register on the Weston number 609 "Illuminometer." Customers are found to be very responsive to suggestion after the science of seeing is explained and they are anxious to make the change, although it usually involves an initial investment of $350 to $600 and an increase in their lighting bill from $8 to $10 per month, to as much as $60 to $75 per month.

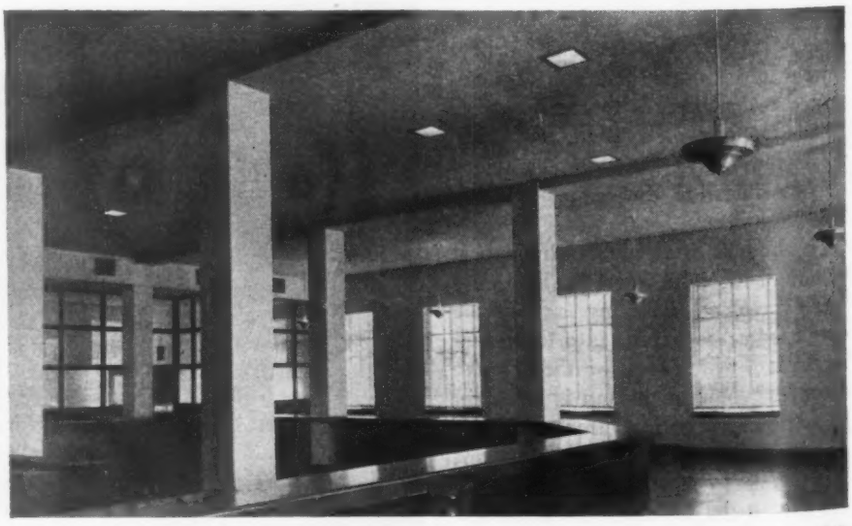
We design these installations for 10 ft.-candles general illumination, supplemented, where needed, with 55 to 65 ft.-candles. The gin yards are always floodlighted.

These new lighting installations reduce accidents, reduce fire hazards, increase employee morale and increase production, and they are excellent advertising for the gin operator. We were informed that production is increased from two to five bales per day, depending upon the size of the gin.

Since the ginner nets from $2.50 to $4 per bale ginned, it is easy to see why he is willing to increase the operating cost total. It leaves a net profit of $40 to $200 per month.

Due to the short ginning season, even in good crop years, and the wide variation in total cotton ginned from year to year, some feel that this field is not worth developing. I do not agree. In our case the possible increased revenue is $46,000 annually. For practical reasons this may never be reached, but we can develop a new income of approximately $21,000 annually from this source.

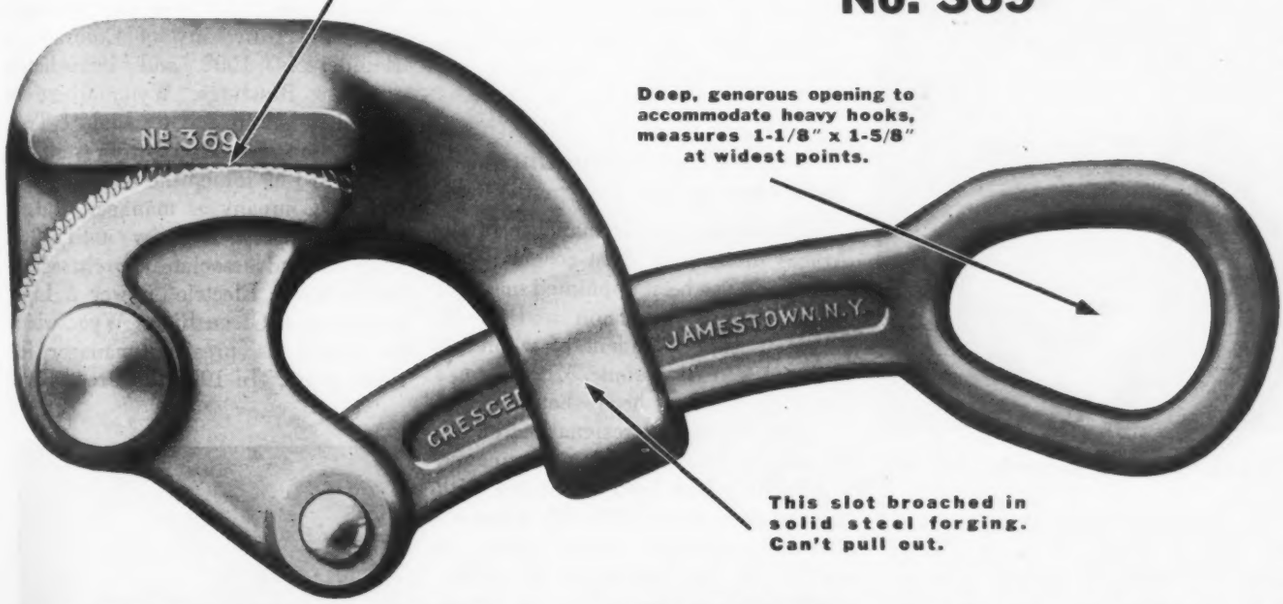
FOR MODERN COUNTER LIGHTING



Modern lighting is built in to the walls and ceilings of the Hall of Records, Fresno's (California) newest public building. For example, supplementary direct lighting from 300-watt Holophane ceiling units with control lenses brings intensities on the counter of this office above the practical level provided by the 750-watt, totally indirect luminaires. Ceiling units are spaced one per bay over the counter—about 10 ft. apart—and luminaires spaced 12 ft. apart. Lighting arrangement is not symmetrical, but is designed for the room.

NEW

Crescent HAVEN'S GRIP No. 369


Redesigned curve provides maximum grip on all wire sizes within capacity.
Deep, generous opening to accommodate heavy hooks, measures 1-1/8" x 1-5/8" at widest points.
№ 369
JAMESTOWN, N.Y.
This slot broached in solid steel forging. Can't pull out.

SAFE LOAD 5000 lbs.: CAPACITY, 1/8 to 1/2 inch

A new Haven's Grip with many noteworthy improvements that every lineman will appreciate. Forged from alloy steel and heat-treated, this improved Grip will easily withstand loads up to 5000 lbs. Note the deep and generously-sized eye, shaped to accommodate the heavy hooks now in popular use. The Jaw curve also has been redesigned so that maximum grip is obtained on *all* wire sizes within the capacity range. A compact, well-made tool durably finished in Cadmium plate. Wt. 2 lbs., 7 oz. Fully guaranteed. Try this new Grip and note its greatly improved performance.

CRESCENT TOOL CO., JAMESTOWN, N. Y.

CRESCENT and Smith & Hemenway TOOLS

News ABOUT PEOPLE

C. P. Randolph Vice-President of Edison G.E. Appliance

C. P. Randolph, widely known for his contributions to the electric range and water heating industry, has been elected vice-president of the Edison General Electric Appliance Company,

Chicago. He was formerly chief engineer.

Mr. Randolph entered the service of the General Electric Company as assistant to William Stanley, inventor of the transformer, and worked with Mr. Stanley developing the first General Electric electric range.

Later he was made managing engineer of the heating device department in the Pittsfield Works of General Electric, and in 1918, when this unit of the company was consolidated with the Hughes Electric Heating Company and the Hotpoint Company to form the Edison General Electric Appliance Company, Mr. Randolph went to Chicago as chief engineer.

•

▶ RICHARD C. WENZEL has resigned as rate analyst for the Wisconsin Public Service Commission to become assistant to the general manager of the Northern Indiana Public Service Company. Mr. Wenzel has been connected with the Wisconsin commission for five years.

▶ GERARD SWOPE, president of the General Electric Company, was the guest of honor at a dinner given recently at the Savoy Hotel, London, by Sir Felix J. C. Pole, chairman of the Associated Electrical Industries. Most of the best-known leaders of the British electrical industry were present.

•

Georgia Power Announces New Operating Assignments

Thomas A. Gibson, manager of the Athens division of the Georgia Power Company, has been appointed manager of the Augusta division and L. M. Shadgett, superintendent of wholesale operations, will assume Mr. Gibson's former duties in Athens—both changes resulting from the resignation of W. W. Barr, Augusta division manager.

Mr. Barr had been connected with the company since 1922. Mr. Gibson's promotion follows many years of service in the operation of public utilities in Athens. He was superintendent of the Athens Railway & Electric Company when that property was consolidated with Georgia Power in 1926 and he became superintendent of the Athens division. Subsequently he became assistant division manager and then division manager. Mr. Shadgett is an electrical engineer of many years' experience and has been prominently identified with national engineering societies. He was a member of various committees of the old National Electric Light Association. At the present time he is a director of the Atlanta chapter of the American Institute of Electrical Engineers.

John F. Pennington, supervisor of substation and equipment maintenance, succeeds Mr. Shadgett as superintendent of wholesale operations.

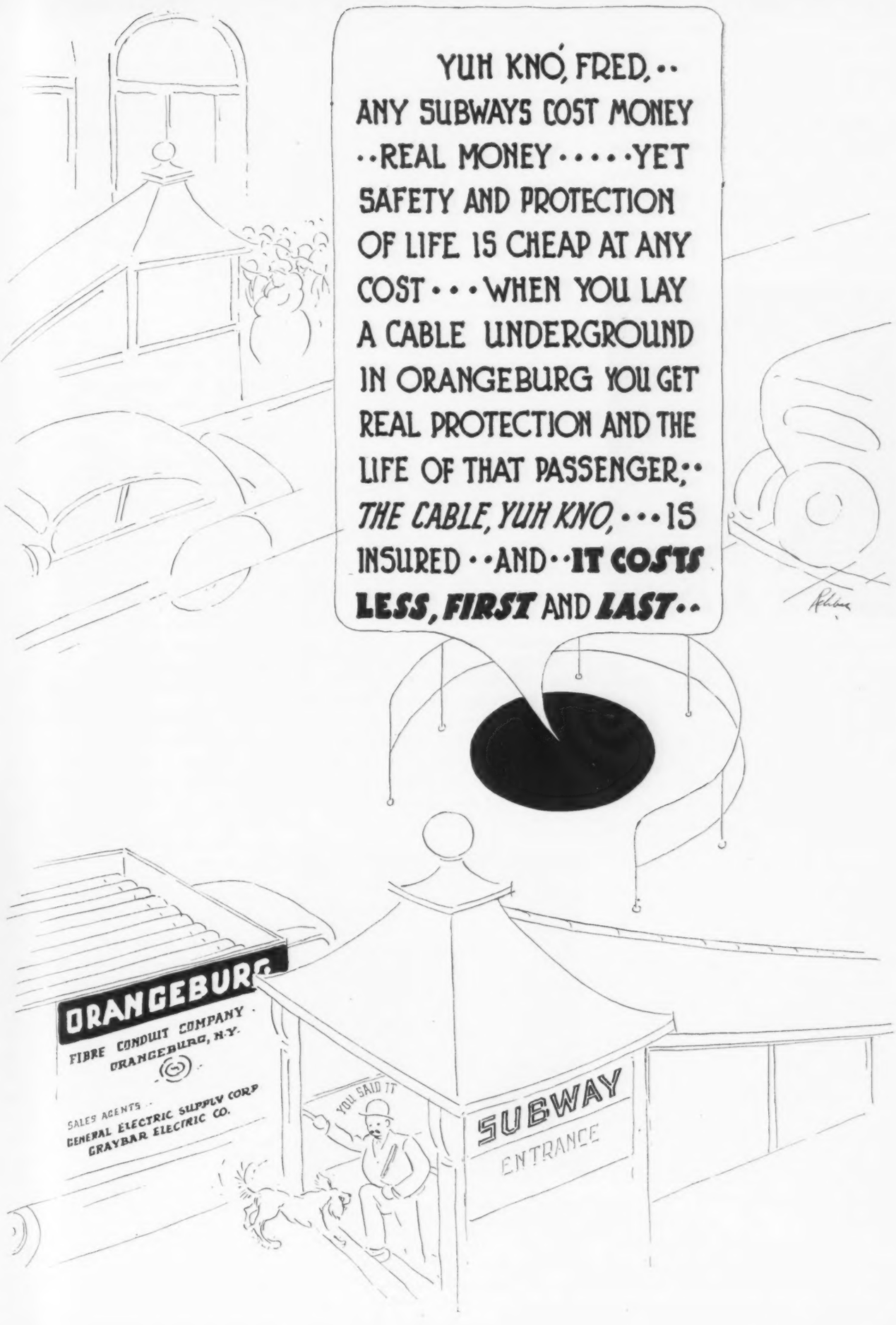
J. H. Jacobucci New President of Rocky Mountain League

J. H. Jacobucci, who has been elected president of the Rocky Mountain Electrical League, is division manager of the Utah Power & Light Company at Green River, Wyo. Born in Italy, Mr. Jacobucci emigrated with his family to the United States when he was 11 years old. He was graduated from the University of Colorado at Boulder in 1908 and immediately went to Rawlings, Wyo., where he joined the United States Light & Traction Company's engineering staff.

In 1910 he joined the Rawlins Light & Fuel Company as manager, and remained in that capacity until 1917, when he and associates purchased the Green River Electric, Power & Light Company at Green River, Wyo., which he served as president-manager for seven years. In 1925 the Green River

properties were sold to the Utah Power & Light Company, becoming a unit of the parent corporation. Mr. Jacobucci was made division manager, the position he continues to hold.

Since the inception of the old Rocky Mountain Electrical Association's program several years ago, linking utili-


YUH KNO, FRED,..
ANY SUBWAYS COST MONEY
..REAL MONEY.....YET
SAFETY AND PROTECTION
OF LIFE IS CHEAP AT ANY
COST...WHEN YOU LAY
A CABLE UNDERGROUND
IN ORANGEBURG YOU GET
REAL PROTECTION AND THE
LIFE OF THAT PASSENGER;..
THE CABLE, YUH KNO,...IS
INSURED..AND..IT COSTS
LESS, FIRST AND LAST..
ORANGEBURG
FIBRE CONDUIT COMPANY
ORANGEBURG, N.Y.
SALES AGENTS
GENERAL ELECTRIC SUPPLY CORP
GRAYBAR ELECTRIC CO.
YOU SAID IT
SUBWAY
ENTRANCE

ties and electrical merchants in friendly co-operation, Mr. Jacobucci has taken a prominent part in the rapidly growing scope of activities.

•

J. May Assumes New Duties With American Steel & Wire

John May, who was recently elected vice-president in charge of sales of the American Steel & Wire Company, became associated with that organization in 1909, when he entered the order

department in New York. Subsequently he served as assistant to the educational director, Worcester, Mass., and in the electrical and wire rope sales division, New York.

In 1931 he was made assistant general manager of sales of the company and early this year was appointed to the position of general manager of sales. In his new executive position Mr. May succeeds Dennis A. Merriman, who is retiring after spending more than forty-six years with the company and its predecessors.

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▶ PHILIP H. PORTER has been named chief counsel of the Wisconsin Public Service Commission, succeeding Alvin C. Reis, who is now a Dane County circuit judge.

▶ CAMERON G. WILL, engineer examiner for the PWA in Olympia, Wash., has resigned to become engineer in charge of construction at Ruby Dam for the city of Seattle. Mr. Will was identified with PWA for four years. Previously he had been on the Seattle city engineering staff.

▶ COL. JULIAN L. SCHLEY, who will become Chief of Engineers, U. S. Army, October 18, is making a trip of inspection which includes the Fort Peck and Bonneville Dams. He also will visit Seattle, Portland, San Francisco and Los Angeles and the Las Chonchas Dam. Colonel Schley will not reach Washington until the last week of October.

▶ D. P. CALDWELL has been appointed northern division manager of the Florida Power & Light Company with headquarters at Daytona Beach. Mr. Caldwell has been a resident of Miami since 1927, when he joined the power company as assistant to H. H. Hyman, southern division manager. He became manager of the Miami district in 1928 and in 1931 was made southern division sales manager. Since January, 1936, he has been working out of the general office in Miami. He succeeds F. M. Wilkerson.

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Westinghouse Supply Elects Bonnell W. Clark President

Bonnell W. Clark, vice-president and general manager of the Westinghouse Electric Supply Company, has been elected president of the company with headquarters in New York.

Mr. Clark entered the electrical wholesaling business in 1906, with the Robertson-Cataract Electric Company at Buffalo, N. Y. He has been continuously in electrical wholesaling since that time, except during the period from 1916 to 1920, when he served the Gould Storage Battery Company as sales manager.

He joined the Westinghouse Electric Supply Company in 1925 as

special representative. In 1929 he became general manager and three years later vice-president and director. Mr. Clark served as chairman of the National Electrical Wholesalers Association from 1930 to 1932.

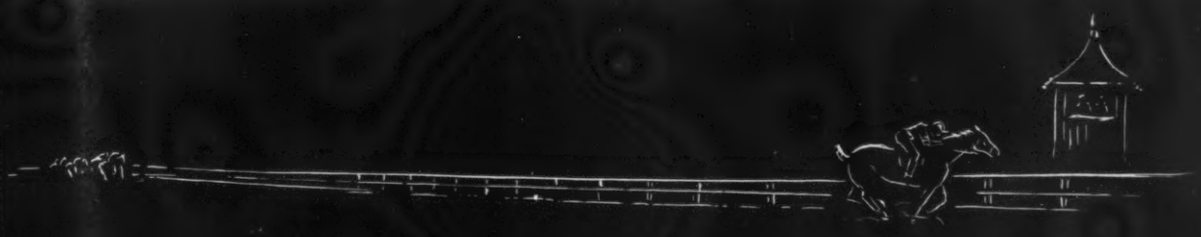
OBITUARY

▶ J. HOWARD STURGE, superintendent of the Bergen County division of the Public Service Electric & Gas Company of Newark, N. J., died September 25, of a heart attack, at his summer home in Indian Lake, N. Y. His age was 51.

▶ LEROY C. WILLIAMS, well known in the electrical industry on the Pacific Coast, died in Los Angeles, September 19. He was chief specification and materials engineer, Procurement Division, U. S. Treasury Department, Los Angeles, at the time of his death. He was a past-chairman of the Los Angeles section, A.I.E.E., and a member of the Electric and Engineers' clubs in that city.

▶ EDWIN NORTH, assistant secretary and purchasing agent Westchester Lighting Company, Mount Vernon, N. Y., died suddenly near his Babylon, Long Island, home August 14. He was 61 years old. Mr. North was associated with the Consolidated Gas Company for twenty years—1897 to 1917. From 1923 to 1926 he was with the Brooklyn Union Gas Company. Then he was named purchasing agent of Westchester Lighting, becoming assistant secretary also in 1929.

▶ COL. WARREN R. THOMPSON, construction engineer with the Cities Service Company since 1923, died September 26, of a heart attack, at his home in New York. He was in his sixtieth year. A graduate of Pennsylvania State College in 1897, Mr. Thompson spent several years with J. G. White & Company, New York, and later became associated with J. G. White & Company, Ltd., of London. In 1903 he took a position with the British Westinghouse company and in this connection had much to do with problems of power-house design and heavy steam railroad electrification. When he returned to this country he rejoined J. G. White & Company. In 1908 he became assistant electrical engineer for the New York Public Service Commission and one year later he was appointed acting electrical engineer of this commission. He resigned to affiliate himself with H. M. Byllesby & Company of Chicago as assistant chief engineer. In 1913 he was named manager of engineering and construction. He remained with the Byllesby organization until 1923 except for two years in military service.



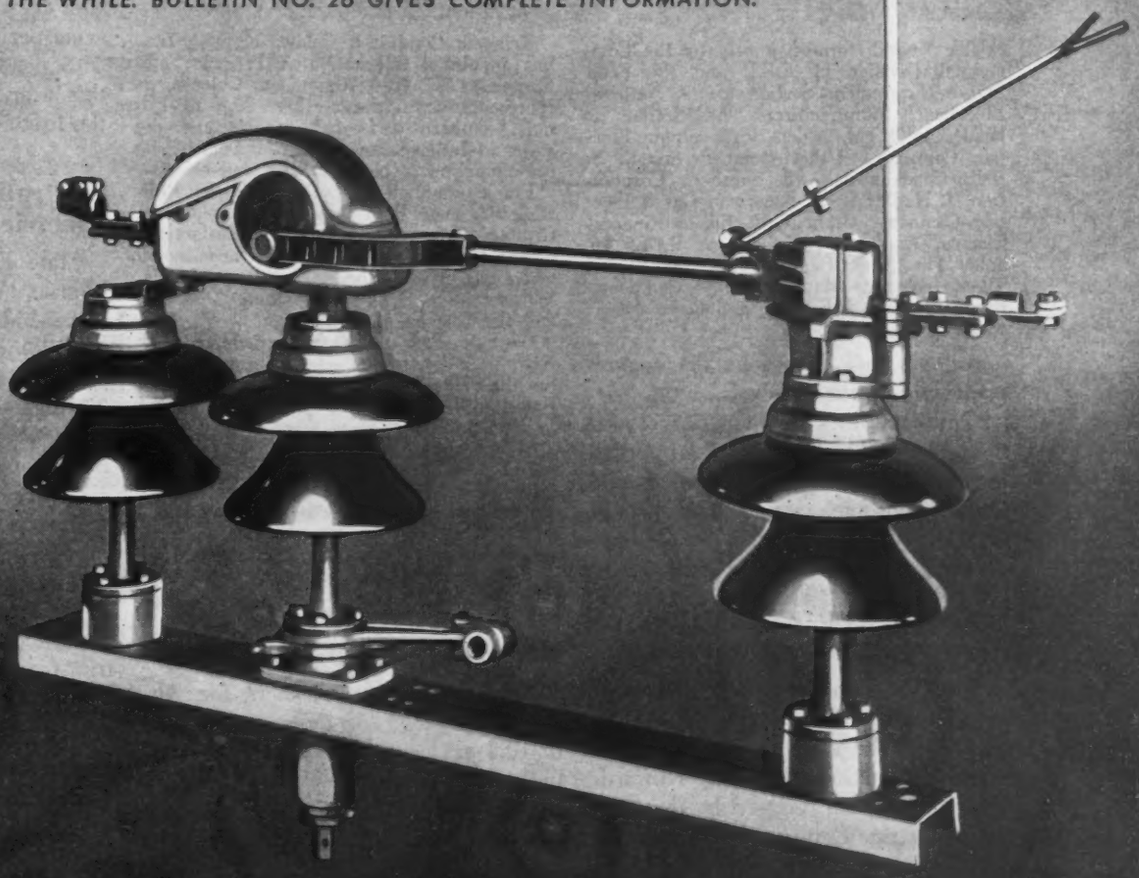
"WAY OUT IN FRONT"

Five years ago there were **three** good makes of air-break switches traveling along neck-and-neck . . . well ahead of all others . . . and HI-VOLTAGE was one of them.

Since then we have assured dependable operation under all weather conditions by adding the following exclusive features.

1. **Totally enclosed bronze operating mechanism.**
2. **Monel ball bearings.**
3. **Graphite insert bearings.**

NOW HI-VOLTAGE *IS WAY OUT IN FRONT . . . GAINING ALL THE WHILE. BULLETIN NO. 26 GIVES COMPLETE INFORMATION.*



- TYPE S-W VOLTAGE TO 34.5 KW
- WRITE FOR BULLETIN NO. 26

HI-VOLTAGE EQUIPMENT CO.

2891 EAST 79TH STREET • CLEVELAND, OHIO

Manufacturing AND MARKETS

Commercial Cooking Council Organized

"National distributors and local retailers of commercial electric cooking equipment for counter and pantry should focus early attention on the potential market offered by the 60,000 first-class restaurants and 34,000 substantial drug stores in the United States which operate lunch counters," according to C. E. Greenwood, commercial director of Edison Electric Institute and member of the newly-formed National Commercial Cooking Council.

The council, formed jointly by the Commercial Division of E.E.I. and the Food Service Equipment Section of the National Electrical Manufacturers Association is headed by P. M. Alden, Philadelphia Electric Company. Other members are R. S. Bell, Commonwealth & Southern Corporation, J. Hadley Scott, American Gas & Electric Company, Grant Call, Edison General Electric Appliance Corporation; R. E. Arnold, The Silex Company; M. E. Miner, The Griswold Manufacturing Company; Bruce Fleming, N.E.M.A.; and C. E. Greenwood.

A plan book issued by the council presents a market analysis of the market and outlines a cooperative promotional and sales campaign toward the electrical modernization of restaurant and lunch-counter kitchens and grills.

•

General Electric Releases New "Talkie" for the Farm

Combining entertainment with education in the advantages of electric service on the farm and in the farm home, the talking film "Bill Howard, R.F.D." has been released by the General Electric Company for use by agencies working on rural electrification.

Wiring, lighting, home laundry equipment, electric kitchen and radios are featured in use in the home, while outside is illustrated the use of electric milking equipment, milk cooling, electric soil heating, electric motors, barn lighting and water pumping. Picture shows conversion of farmer to use of electricity through efforts of son, an agricultural college graduate.

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Manufacturers Make Sales Appointments

Electrical manufacturing companies have recently announced the following assignments to their sales staffs:

Triangle Conduit & Cable Company, Inc., has appointed George Butler Electric Sales Company, 552 West Adams St., Chicago, as representative in the northern half of Illinois, southern half of Wisconsin and the states of Indiana, Iowa and Nebraska for its complete line of conduit, wire and cable.

Frank Campbell Coe, sales engineers, Philadelphia, have been appointed to represent Graham Transmissions, Inc., manufacturer of the Graham variable speed transmission. Their territory will be eastern Pennsylvania, southern New Jersey, Maryland, Delaware and the District of Columbia.

Corning Glass Works has appointed J. E. Nelson, Indianapolis, as its representative for the sale of Pyrex power insulators and Pyrex radio insulators in the State of Indiana.

Appointment of Louis R. Conrath as sales engineer with the B-L Electric Manufacturing company has just been announced. Formerly engaged in laboratory development work with this company, he has just returned to St. Louis after an absence of several years to resume connections with B-L.

•

Vacuum Cleaner Sales Gain

Sales of vacuum cleaners for August totaled 116,242 units, an increase of 10.4 per cent over sales of 105,315 units in the same month last year, according to the Vacuum Cleaners Manufacturers' Association. Eight months' sales were 1,199,412 units, as against 929,839 units in the first eight months of 1936, an increase of 28.9 per cent.

Report Gain in Sales of Laundry Equipment

Sales of household washing machines in the first eight months of 1937 totaled 1,245,520, as against 1,204,227 sold in the first eight months of 1936, according to the American Washing Machine Manufacturers' Association. For the same period sales of ironers amounted to 128,589, an increase of 6.67 per cent over the 1936 period.

Washers retailing at $70 or more showed 36.3 per cent increase in the first eight months of this year over the same period in 1936 and amounted to 41.3 per cent of all factory deliveries this year, as against 31.3 per cent in the first eight months of last year.

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Australian Commissions Ask Electrical Equipment Bids

State Electricity Commission, Melbourne, Victoria, Australia, will receive bids until November 9 for a quantity of automatic induction voltage regulators (Specifications No. 37/76).

Sydney County Council, Sydney, New South Wales, Australia, will receive bids until November 11 for steam turbine and motor-driven feed pumps for installation in the Bunnerong power station, Section B (Specifications No. 163); also until November 25, for 30,000-kva. power transformers for same station (Specifications No. 164).

•

Employment Study Shows Gains by Electrical Makers

The electrical manufacturing industry is sixth among 25 manufacturing industries from the standpoint of increased employment of 1937 over 1929, according to a recent study pub-

"MEGGER" INSULATION TESTING

Insulation is still the most vulnerable part of an electrical machine and "MEGGER" TESTING TELLS THE STORY

. . . according to J. B. Swering, Chief Engineer, Electrical Division of The Hartford Steam Boiler Inspection and Insurance Company

"After more than 15 YEARS of electrical testing experience, including more than 900,000 INSULATION RESISTANCE TESTS, we find that insulation is still the most vulnerable part of an electrical machine. Insulation resistance testing yields more information about a given winding than any other known test, simply and readily applied in the field. For periodic tests of electrical equipment insured by us, we have now standardized on 'Megger' Insulation Testing Instruments." (J. B. Swering)

•

"MEGGER" INSULATION TESTING provides a "case-history" of each piece of apparatus or machine so tested. It enables one to detect readily the presence of dirt and moisture and to guard against deterioration. It gives protection from the dangers of insulation failure—dangers that are present during the entire life of electrical equipment. Obviously it is cheaper to take a machine out of service at some convenient time for necessary attention, than to have it fail unexpectedly and tie up all or part of the plant.

Let us send you reprint No. 837-W, an interesting article on Insulation Protection by the late Mr. K. A. Reed, former Chief Engineer, Electrical Division of The Hartford Steam Boiler Inspection and Insurance Company. Write. No obligation.

"MEGGER"

JAMES G. BIDDLE CO. 1211-13 ARCH STREET PHILADELPHIA, PA.

Insulation Testing Instruments—Ground Testing Instruments—Speed Measuring Instruments—Frequency Meters

lished in *Factory Management and Maintenance*, based on National Industrial Conference Board data.

With 1929 as a basis, index of employment in the electrical manufacturing industry stood at 111.4 as of July, 1937, while the national average among the 25 industries studied was at 102.8.

•

Chicago Air Conditioning Breaks All August Records

Air-conditioning contracts closed in Chicago set a new all-time record for August, both in number and capacity of installations, according to report of the Commonwealth Edison Company.

Contracts were closed for 51 installations, totaling 430 hp., as against 27 installations, totaling 241 hp., for August, 1936. Room-cooler sales totaled 28 for August this year, as compared with eleven room-cooler sales in August, 1936.

•

Electrical Gift Anniversary

The American National Retail Jewelers Association has announced that the eighth wedding anniversary will be officially designated as the "Electrical Appliances" anniversary. Announcement was subsequent to work of the domestic appliance section of the National Electrical Manufacturers Association with representatives of the A.N.R.J.A. to have one anniversary so named.

•

All-American Cable Awards

Bureau of Reclamation, Denver, Colo., has awarded a contract to the Eagle Electric Supply Company, Boston, Mass., for insulated cable for Imperial Dam installation, All-American Canal project, California, at $36,645, item No. 1, and for other insulated cable item No. 3, same project, at $2,621. Cable award under item No. 2 has been made to the Williamsburg Electric Supply Corporation, Brooklyn, N. Y., at $5,897.

New York Metal Prices

	Sept. 30, 1937 Cents per Pound	Oct. 5, 1937 Cents per Pound
Copper electrolytic	12.00*	12.75*
Lead Am. S. & R. price	6.00	6.00
Antimony	17.25	17.375
Nickel ingot	35.00	35.00
Zinc spot	6.85	6.85
Tin Straits	55.625	57.50
Aluminum, 99 per cent	20.00	20.00

* Delivered Connecticut Valley.

Field Reports on Business

Orders for electrical equipment are holding up well, considering the hesitant attitude which has come over all industry. Revival of the new capital market is expected to stimulate construction. The drop in metal prices is expected to result in a more stable market.

NEW ENGLAND

Industrial electrical equipment sales in this district are holding up well, but inquiries are coming in less volume and the generous backlog of negotiations accumullated during late spring and summer is beginning to dwindle quite rapidly. Heavy electrical equipment interest in this area is centered on a few scattered turbogenerators which are being considered for fall purchase; a prominent engineering house in Boston is engaged in engineering studies of a number of power plant additions located in Southern and Middle Western states.

Central station supplies are quiet; watthour meters are selling steadily, and according to one manufacturer are likely to show a 50 per cent increase in volume as compared with 1936. A manufacturer of arc welders reports increasing interest in small portable units, ranging from 50 to 100 amp., and also encouraging sales in battery chargers for garage service.

Electric cooking appliances are gaining in favor, particularly among hotels in this district. Recently an installation of electric cooking equipment involving 79 kw., including a 23-kw. range, three 18-kw. ranges and minor appliances, was bought by the Hotel Kenmore, Boston.

Appliance sales in Vermont are impressive; 3,109 refrigerators, 764 ranges and 158 water heaters have been sold this year to date. Air-conditioning inquiries are slowly gaining; new construction ahead is showing a tendency to lessen in volume, but one engineering contractor reports over $1,000,000 in institutional buildings being estimated at the present time, involving new electric lighting, signaling systems and some air-conditioning equipment.

PACIFIC COAST

Settlement of strikes affected the electrical industry in the Bay region. Besides, relaxed labor tension elsewhere has encouraged the trade to anticipate a fall return of the record-breaking business of early spring. Overstocks of leading wiring staples, however, tend to cut new purchases from manufacturers and wholesalers and weaken stability of the market, though signs of copper price strengthening are encouraging, especially across the Montana-Utah-Arizona copper belt. Industrial prospects include a $2,000,000 paper and pulp plant for Bellingham, Wash.; a carload of copper wire and cable for railroad signaling and telegraph work; additions to two San Francisco lithograph plants; $10,000 of machinery and controls for an electric dredge, and $300,000 produce storage warehouses and silos for Petaluma, San Francisco and Seattle.

Recent machinery purchases in the Bay area include ten 648-kva. regulators, value $25,000, and $40,000 worth of 50 to 333-kva. transformers, while southern California records awards covering $102,870 for a turbine, $119,450 for a generator and $13,571 for a governor and pump, all for an Imperial Valley irrigation hydro plant. Two of the 44 new radio beam communication stations recently awarded to Westinghouse for $700,000 will be constructed in Riverside County. Los Angeles is in the market for 75 15,000-volt potheads for its Colorado River acqueduct. Aerial surveys are to be made for a 1,600 square mile area along the Green and Bear Rivers on the Utah, Idaho and Wyoming border for a new government power project. Excellent natural factors buttressed by such well-scattered public construction is basis for hope for indefinite continuance of good electrical business in all branches.

NEW YORK

Manufacturers are making plans for early exhibition of 1938 models of refrigerators and other electrical appliances. Preliminary orders indicate good future business. Orders for holiday lamps have been placed in the wholesale market by buyers from near-by states. While orders were small and confined to better-price goods, including a wide range of table lamps with bases of imported china, a pickup is anticipated. Floor lamps in modern design are finding favor.

Airtemp, Inc., subsidiary of the Chrysler Corporation, is boosting its campaign on home-heating and air-conditioning equipment. Air-conditioning installations are showing a steady rise, especially in the new home developments.

The gyration in metal prices the past two weeks is considered a healthy development and is expected to result in a more stable market. Refined scrap moved up ¼ cent a pound this week to a basis of 12 cents. The custom smelter who had been selling refined copper for 12½ cents raised the price to 12¾ cents. Abroad copper has had a firm tone. The drop in copper price is expected to stimulate forward buying. The drop should aid the utilities in their construction budgets.

Because of the uncertainty regarding future moves by the Administration, business is still hesitant. Industrial leaders are anticipating a more encouraging outlook.

CHICAGO

Optimism over fall prospects still prevails throughout this area despite spotty general business. Recessions occurred in some lines last week, but were matched by improvement in others as seasonal influences had a tendency to hold things in balance. Industrial activity receded slightly with the exception of the farm implement group, in which the outlook is consistently bright. Building activity slumped still lower.

Substantial gains in net earnings were reported by the Commonwealth Edison Company and the Public Service Company both for the month of August and the first eight months of the year. Electrical wholesalers report a 14 per cent drop in sales from August, but a 33 per cent increase over the same month last year. Manufacturers were encouraged at the favorable showing made at the Iron and Steel Exposition last week, in which the number of inquiries and orders were higher than at last year's exhibit.

Several sizable orders for heavy industrial equipment were placed last week. Wire and cable and fittings are selling in good volume and the progress being made in appliances is encouraging. Lighting equipment continues to move at a brisk pace. Most manufacturers report a high rate of activity, although the increase over last year's levels is gradually being lowered.

Only BERMICO DURA-CELL

builds in High Impact Resistance with

VIRGIN WOOD FIBRE

IT'S strong fibre that puts strength into conduit, that builds in the high impact resistance needed to withstand the shocks and blows suffered during installation. That's why it pays to specify Bermico Dura-Cell—the only conduit made with virgin wood fibre!

Tough, unweakened wood fibre builds high impact resistance into Bermico Dura-Cell! Gives it the shock-resisting strength to "stand the gaff" of rough handling and abuse!

Other paying reasons for specifying Bermico Dura-Cell are:

1. Its greater strength means extra years of trouble-free cable protection.
2. A non-split coupling speeds installation and cuts labor costs.
3. Lighter weight reduces trucking and handling expense.

It pays to specify Bermico Dura-Cell—the only conduit made with virgin wood fibre. A product of BROWN COMPANY, Portland, Maine.

WHY THIS NEW COUPLING CAN'T SPLIT

Driving forces tapered conduit ends solidly against fillet in center of coupling. Pressure is held on direct line through fillet. Ends cannot wedge and press outward to split the coupling.

EXCLUSIVE DISTRIBUTORS
WESTINGHOUSE ELECTRIC SUPPLY COMPANY
BRANCHES IN EVERY LARGE CITY

BROWN COMPANY

FOREMOST PRODUCERS OF PURIFIED CELLULOSES FOR QUALITY PRODUCTS

New EQUIPMENT AVAILABLE

"Silent" Insulators

These radio interference-proof pin-type insulators employ a metallized crown and a high resistance glaze with copper oxide as a base, for eliminating radio interference

Radio interference-proof insulators, for power and distribution lines. **Westinghouse Electric & Mfg. Co.**, East Pittsburgh.

caused by arcing flow of charging current from conductor and tie-wire into insulator or from insulator to pin in pinhole. Among advantages claimed for copper oxide glaze is that it inherently provides necessary gradient to damp out any corona discharge at extreme edge of metallized area.

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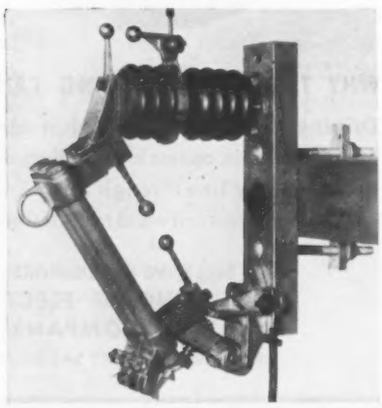
Surge Protector

This new device for protecting electrical equipment from overvoltages, such as may be caused by lightning, and the consequent damage caused by the flow of current following spark gap breakdown, makes use of five spark gaps. Two of the gaps are easily visible on the outside of the device and one is in each of the three fuse holders. In the event of an overvoltage surge one of the inside gaps, and probably two, will break down, the follow current melting the 15-amp. fuse link and being dissipated inside the fiber tube. A second and third overvoltage surge will be handled in the same manner by the other two tubes. Should all three fuse links be blown before they can be replaced additional overvoltage surges will be bypassed to the ground through the outside gaps.



"Protectofuse;" sizes to handle voltages from 6,900 delta to 46,000 Y, all designed for 7,500 amp. interrupting capacity. **W. N. Matthews Corp.**, St. Louis.

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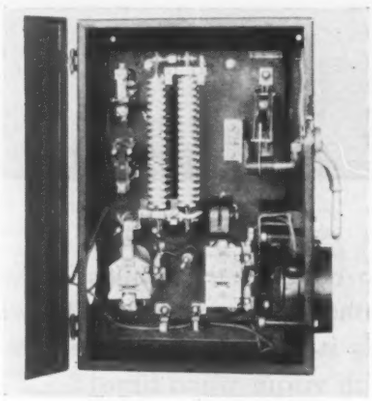
Starter for Mining Duty

Designed for mine service, this new heavy-duty d.c. starter provides two-point acceleration for constant-speed motors, shunt or compound wound, rated 1 to 20 hp., up to 600 volts. Among its features are thermal



"CR4061-C1B;" magnetic d.c. controller for mine service. **General Electric Co.**, Schenectady.

and instantaneous overload protection, externally operated line switch capable of interrupting load, field-adjustment rheostat to compensate for line variations and correct operation on line fluctuations of 150/300 or 325/600 volts.

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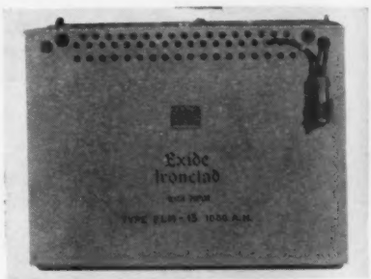
Stress Relieving Heaters

"Wrap-around" coil type heaters; for maximum temperatures of 1,200 deg. F. **H.O. Swoboda, Inc.**, New Brighton, Pa.

Newest additions to this company's line of electric, stress-relieving heaters are "wrap-around" coil types, provided with insulating bushings over their entire length and designed for directly wrapping around joints, etc., for heating carbon-molybdenum pipe during welding and for subsequent stress relieving, as well as for stress relieving plain carbon steel pipe where joints are not readily accessible. To heat pipe uniformly on both sides of joint with these heaters it is necessary to use at least two of each size, according to the makers.

Industrial Truck Battery

Said to be the world's largest battery for electric material-handling trucks, this complete sixteen-cell battery, assembled in a steel tray, occupies a space of 26 x 51 in.,



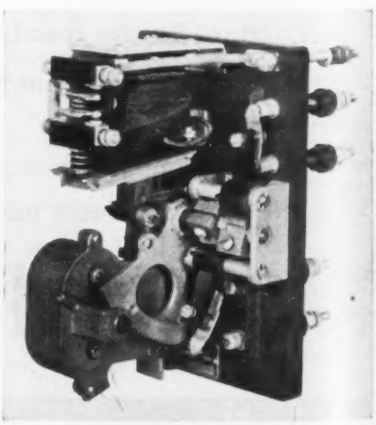
'Super-type FLM—13 Exide-Ironclad;" capacities, 33 kw.-hr.; 1,080 amp.-hr. at normal six-hour discharge rate. **Electric Storage Battery Co.**, Philadelphia.

37½ in. high, weighs 2½ tons. In double-shift service, steel tray assembly is said to permit quick exchanges and continuous, dependable service, since the steel tray may be rolled or lifted from the truck when one battery is discharged and a freshly charged battery installed in its place.

•

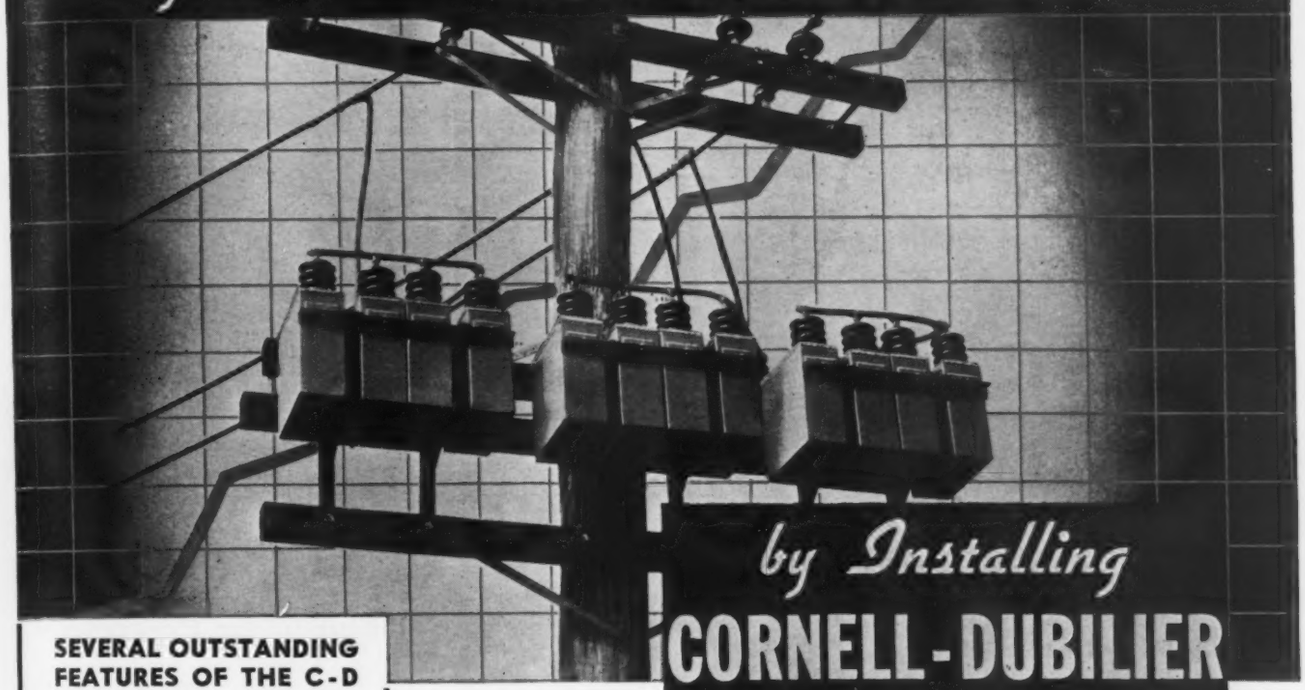
Definite-Time Relay

Of particular importance to machinery manufacturers and users should be a new definite-time relay employing a clutch-type time-delay interlock, developed to provide a reliable means of timing a sequence of operations in a control system. Relay consists of solenoid and plunger mechanically connected to time-delay mechanism and to



"CR2820-1729;" in a.c. or d.c. forms; two, four or six circuits. **General Electric Co.**, Schenectady.

GET FULL System KW Capacity FROM PRESENT EQUIPMENT



by Installing CORNELL-DUBILIER POLE-TYPE CAPACITORS

SEVERAL OUTSTANDING FEATURES OF THE C-D POLE-TYPE CAPACITORS ARE ILLUSTRATED BELOW

1—Negligible operating costs.
2—Low installation costs. Units mount on cross-arms of poles by means of simple bracket.
3—Special housings or foundations entirely eliminated.
4—Special construction and weather-proof coating permits out-door operation year-in and year-out.
5—Flexible . . . any desired capacity can be accommodated by utilizing two or more units as illustrated in photo.
6—Impregnated and filled with non-inflammable and non-explosive DYKANOL.
7—Rugged glazed porcelain insulators. Extra strong to withstand handling in the field. Large petti-coats minimize flash-over dangers.

The problem presented by lack of system capacity due to increased loads and poor power factor—are efficiently and inexpensively being solved by the installation of C-D pole-type capacitors for correction of power factor on distribution systems.

The tremendous savings effected are illustrated by a case history of a capacitor installation.

Cost of added feeder and generator equipment, to bring system capacity to required level would have been . . .	$40,000.00
Similar results were obtained by a capacitor installation costing	$ 7,000.00
Net savings	$33,000.00

Investigate this low cost method of increasing feeder capacity. Savings alone will pay for cost of capacitor equipment within twelve to eighteen months.

C-D engineering field offices throughout the United States will gladly cooperate with you in planning your requirements. Full technical data supplied on request. Send for Catalog No. 143 today!

WORLD'S LARGEST AND OLDEST MANUFACTURER OF CAPACITORS

CORNELL-DUBILIER Electric CORPORATION

South Plainfield, N. J.

CORNELL-DUBILIER ELECTRIC CORPORATION EW 109
SOUTH PLAINFIELD, N. J.

Please have your representative call ☐ send catalog ☐

Name.....

Address.....

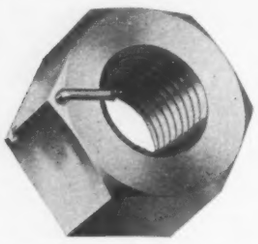
City.....State.....

shaft-operating clutch fingers. On d.c. forms, separate small instantaneous cutout switch is mounted on front of solenoid. Coil springs are said to give constant pull on timing mechanism throughout operating cycle.

•

Self-Locking Nuts

Nuts that automatically lock themselves and remain locked until removed or loosened with an ordinary wrench are a recent development. Locking feature is provided by a chrome vanadium steel pin, integral with the nut, traveling between the threads of



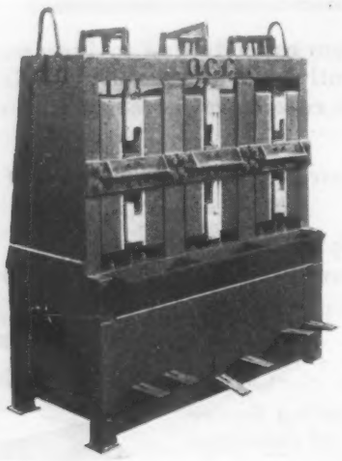
"Anco" made for any standard thread. **Automatic Nut Co.**, Lebanon, Pa.

the bolt. In doing this, the pin bites into the threads at a fixed angle, acting as a ratchet in the tightening of the nut. Pressure with a wrench moves the pin to a new angle and removes the ratchet action, permitting easy loosening or removal, according to the makers.

•

Double-Deck Rivet Heater

Contact resistance method of heating is employed by this electric double-deck, six-electrode rivet heater, designed for heating



"a.c.f. Berwick" electric No. 3 six-electrode, three-phase, double-deck rivet heater. **American Car & Foundry Co.**, New York.

any diameter or length of rivet from ¾ to 2 in. in diameter and from 2 to 11 in. under the head. Due to the speed of electric heating, it is claimed that scale is reduced to a minimum.

•

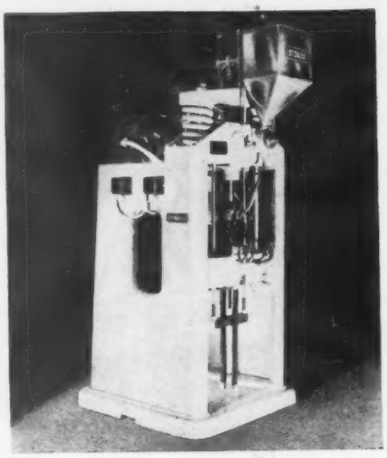
Deep-Well Pump Motors

General Electric Co., Schenectady.

A new line of vertical hollow-shaft motors has been developed for deep-well pumping service. Simplified oiling system for the top (thrust) bearing, ball-type guide bearing, high full-load speed, adequate starting torque, double-end ventilation and full mechanical protection are said to be the features of the line.

Plastics Molding Machine

Designed for the molding of thermo-setting plastics materials of the phenolic base and urea compounds types, this machine is completely automatic. That is,



Automatic molding machine; ram drive motor, 3-hp., separate control drive motor, 1/50 hp., with speed reducer operated by timer, range two seconds to twenty minutes. **F. J. Stokes Machine Co.**, Philadelphia.

with the hopper filled, metering device adjusted to feed proper amount of molding powder and machine set for correct breathing and curing time and mold temperature, the production cycle will be repeated, automatically and without operating attention, an indefinite number of times. If anything happens to interrupt continuity in discharge of finished parts, automatic controls stop machine. Machine is said to require only electrical and air connections.

•

Temporary Pole Step

Consisting of a malleable iron step with chain attachment, this device may be used between ground and first step and at the top of pole, when lineman is working on crossarms or wire connections. Design is said to be such that pressure wedges and tightens chain grip. Device may be used on wood, metal or cement poles.

Temporary pole step; may be made by any malleable iron foundry.

•

Power Fuse

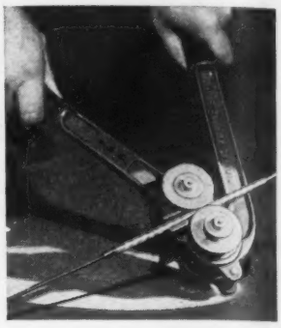
Type BA, "De-ion" power fuse; 34.5 kv., 200 amp. **Westinghouse Electric & Mfg. Co.**, E. Pittsburgh, Pa.

For service in medium-capacity generating stations and substations of all types where short-circuit capacity does not exceed 600,000 three-phase kva. a new 34.5-kv., 200-amp. disconnecting power fuse is available. The fuse, which is arranged for vertical mounting, is hinged at the lower contact to open approximately 75 deg., for use as a disconnecting switch that can be operated by a standard hookstick.

•

Sleeve Splicing Machine

This new sleeve splicing machine for connecting conductors in sizes through No. 3 solid B & S incorporates a special clutch



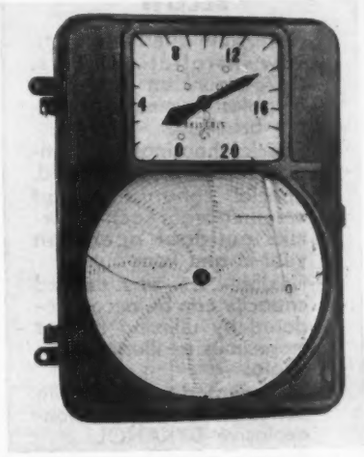
"No. 6-1 ABC" splicing machine. **James R. Kearney Corp.**, St. Louis, Mo.

construction in a light-weight, compact, hand-operated unit. Roller bearings are used to minimize frictional load and assure easy operation.

•

Potentiometer Pyrometer

For recording and indicating thermocouple temperatures, this new potentiometer pyrometer provides for direct marking on a 12-in. round chart and scale indication



"Indicating Recording Pyromaster." **The Bristol Co.**, Waterbury, Conn.

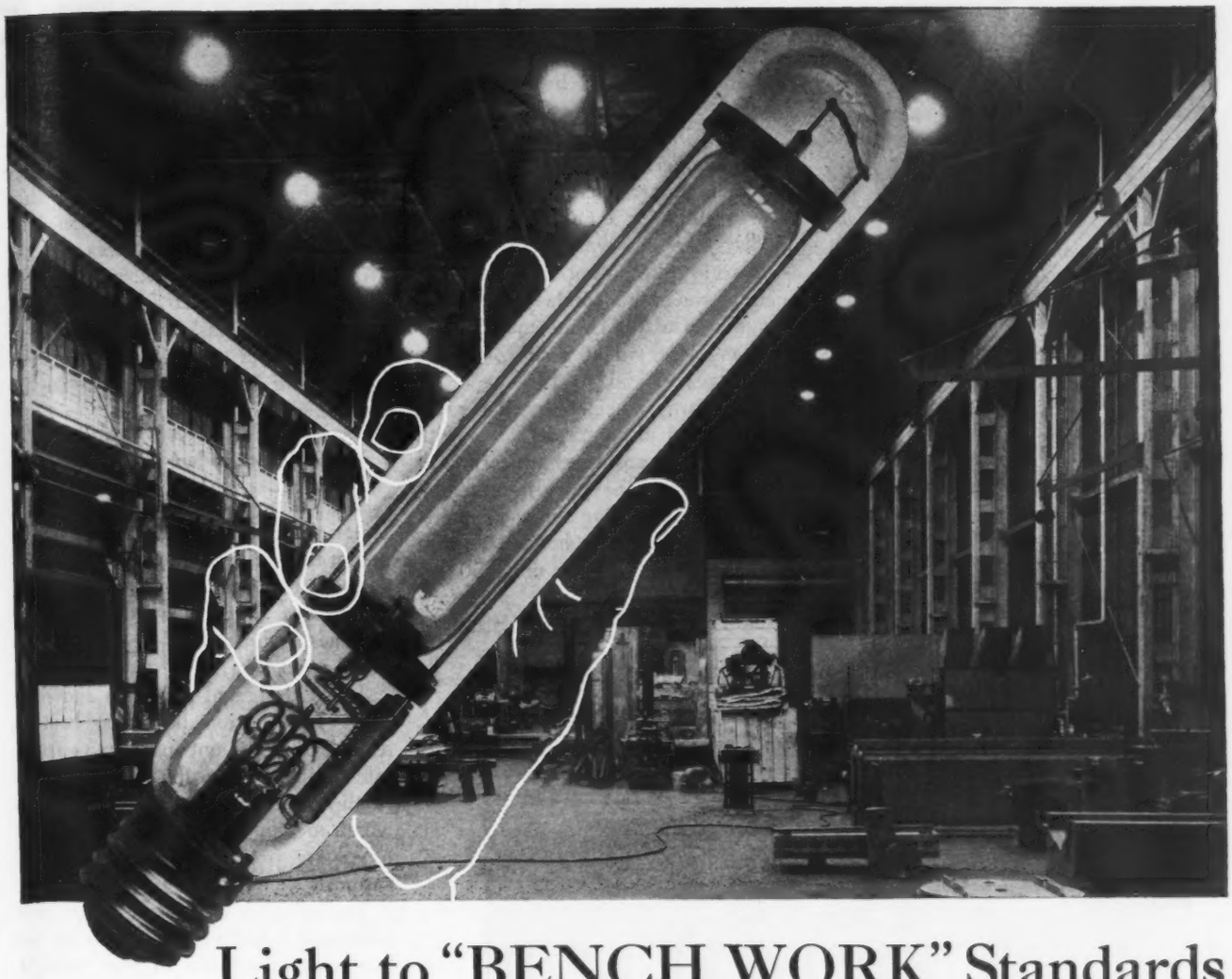
on dial. Operating mechanism consists of highly dampened galvanometer, pivoted in jeweled bearings; relay unit, actuated by galvanometer to operate motor that balances emf. from termocouple and positions recording pen arm and scale indicator; standardizing unit; "power pack," and potentiometer or recording and indicating units.

•

Ammeters

"Tong Test." **Columbia Electric Mfg. Co.**, Cleveland.

In order to insure greater accuracy in measuring currents up to 800 amp., this company is making the frames of these instruments of die cast aluminum alloy. These ammeters clamp over the conductor, measuring a.c. and d.c. without breaking the circuit.



Light to "BENCH WORK" Standards in the High Bay . . .

The 400-Watt Mercury Lamp is 60 to 140% more efficient than other available light sources. It burns vertically only.

By combining Mercury and Incandescent Lamps in many conventional type luminaires, a psychologically cool, white light can be obtained.

Here, 400-watt mercury lamps mounted above the craneway give high and uniform illumination at low operating costs. No other comparable light source gives as much light per watt as these modern lamps. "Bench work" standards of lighting are maintained even in the high bay.

Better lighting through the use of mercury lamps is a profitable procedure. Better light is a production "tool" which directly improves the efficiency of every worker and every other production tool used in industry.

If you are interested in more uniform products at less cost it will pay you to investigate the possibilities of Type H General Electric Mercury Lamps. Complete information is yours for the asking.

Order your auxiliary devices which were designed especially for this lamp from the General Electric Vapor Lamp Co.

GENERAL ELECTRIC

General Electric Vapor Lamp Co. 809H Incandescent Lamp Department
805 Adams Street, Hoboken, N. J. Dept. 165, Nela Park, Cleveland, Ohio

Bus Design at Waterside Features Reliability

[*Continued from page 66*]

tape, followed by two thicknesses of cotton tape filled and coated with insulating varnish. All fittings are hand wrapped.

Insulation at high level

The wrapped bus has been designed to withstand a test of 58 kv. for one minute and the bus insulators to withstand a test of 45 kv. for one minute.

In dielectric strength tests made by the test bureau of the Consolidated Edison Company a specimen of the synchronizing bus withstood a test voltage of 90 kv. for twenty seconds without puncturing.

Corona tests made by the test bureau on the same specimen of bus mounted on its insulator supports indicate that this type of bus construction is remarkably free of corona.

A camera, a radio set and a cathode-ray oscilloscope were used for these tests and the ambient temperature and humidity were varied by special control.

At one time the bus was exposed to air at temperatures from 22 to 25 deg. C. at approximately 85 per cent relative humidity for 65 hours. During tests the bus was energized with a 60-cycle alternating potential applied between the conductor and the grounded insulator frame and the voltage was increased at a uniform rate of 5 kv. per second.

Corona was detected by the radio at 26 kv. and photographs taken with a ten-minute exposure show corona at 30 kv. between the porcelain insulators and the adjusting screw adapters. Photographs show, however, that corona does not appear until 50 kv. at the contact between the porcelain insulators and the tape insulation of the bus.

With the bus located in a darkened room, inspection with the unaided eye failed to reveal visible corona at 58 kv.

It is interesting to note that when the lead gaskets between the porcelain insulators and the adapters were removed and the unglazed end surface of the insulators was painted with a mixture of graphite and nitro-cellulose lacquer a discharge was detected with the radio at 49 kv., as compared with the value of 26 kv. found when using the lead gaskets and a value of 21 kv. found with the gaskets removed and prior to painting the insulator surface.

Novel design of disconnects

The same arrangement of phase isolation and the utilization of the compression strength of porcelain insulators has been incorporated in the design of the bus disconnecting switches, which are also somewhat novel in design.

In the design of the gears and shaft drive lost motion has been kept to a negligible amount in order to facilitate timing. When the switch blade is in the closed position four insulators which are mounted at 90 deg. to each other are provided at each point of support.

The switches are rated 23 kv., will withstand a test voltage of 73 kv. for one minute and are of the "straight line," high-pressure spot construction with silver-to-silver contacts. Necessary operation indicating devices and key interlocking are provided on all switches. Switch units of similar rating are all alike and are interchangeable irrespective of the type of mounting.

Mechanically, the bus structures and the disconnecting switches are designed to withstand the stresses caused by a short-circuit current of 120,000 amp., asymmetric value.

Buses and disconnecting switches are to carry full rated current with a temperature rise not to exceed 30 deg. C. above an ambient of 40 deg. C. outside of their respective housings. Tests indicate that the temperature rise of this equipment is well below the guarantee value.

In the installation of the high-duty bus oil circuit breakers use has also been made of phase-isolated, metal-inclosed construction. In this case, however, standard oil circuit breakers were purchased and separate gas-tight metal housings were fabricated in the

[*Continued on page 141*]

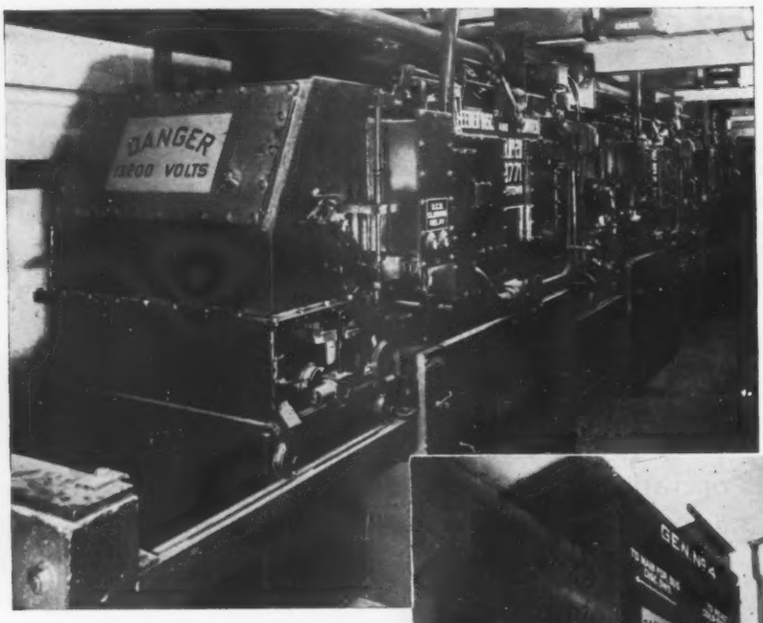


Fig. 8—New switch unit for grounding, testing or de-energizing outgoing feeders

Each feeder is equipped with a submersible type ground and test switch unit manufactured by the Westinghouse Electric & Manufacturing Company. The feeder can be grounded or connected to a test bus, shown immediately above the switch unit. A non-automatic draw-out type oil circuit breaker is provided as part of this unit by means of which single-phase or three-phase ground may be applied for the purpose of de-energizing the feeder.

Fig. 7—Metal housings inclose breaker bushings

The metal housings on a General Electric generator oil circuit breaker which inclose the circuit breaker bushings and the flexible links supplied by the Burndy Engineering Company for connecting the breaker terminals to the buses.

field for each of the oil circuit breaker bushings.

Construction and operation simple

From the standpoint of installation and maintenance, this new type of bus construction offers the advantage that handling of the equipment and construction work are simplified by the fact that no bulky pieces need be handled.

The supporting structure is readily assembled, after which the ground grid, the disconnecting switches and the insulator rings are mounted. The bus conductors are then put in place and the field connections are bolted together and taped. The last operation consists of installing the bus housings.

Local conditions permitting, completely assembled bus sections may of course be readily installed.

One of the features which has greatly contributed to simplify and expedite the installation and reduce labor costs has been the absence of laborious field fitting and the open type of bus construction, which by its greater accessibility improves working conditions.

Another somewhat novel feature of design in the revamping of the galleries is the type of switch unit used for grounding, testing or de-energizing the outgoing distribution feeders (Fig. 8).

Construction work in the galleries is well under way and two sections of metal-inclosed buses and switching equipment have been in service since May 1, 1937.

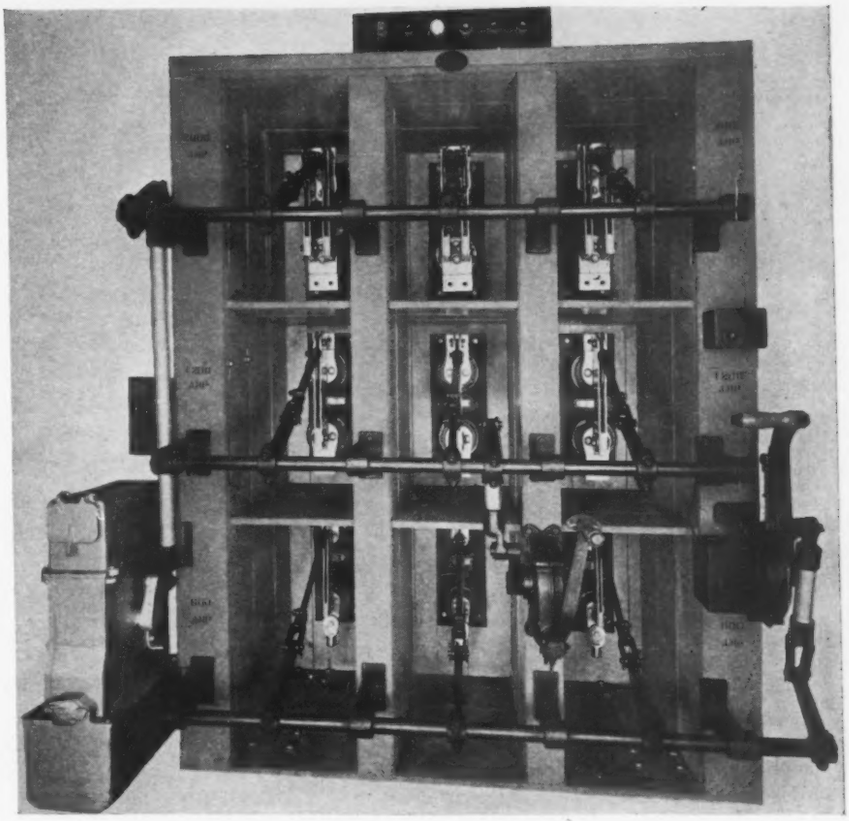
Two additional sections were placed in service last August, bringing to approximately 1,700 lineal feet the total amount of single-phase, metal-inclosed bus at present in operation.

Four additional sections will be placed in service during the early part of next year, at which time two-thirds of the ultimate electrical gallery capacity will have been modernized.

•

Westinghouse Gets Contract

City Water and Light Commission, Fairmont, Minn., has awarded a contract to the Westinghouse Electric & Manufacturing Company for a 2,500-kw., high-pressure, condensing bleeder-type steam turbo-generator unit, for installation in municipal electric power plant at a price of $87,000.



Safety:

—illustrated by three types of group-operated, 3-pole indoor disconnecting switches in the Elpeco Showroom:

TOP ROW
2000 ampere operated by motor mechanism

MIDDLE ROW
1200 ampere, operated by worm and wheel manual mechanism

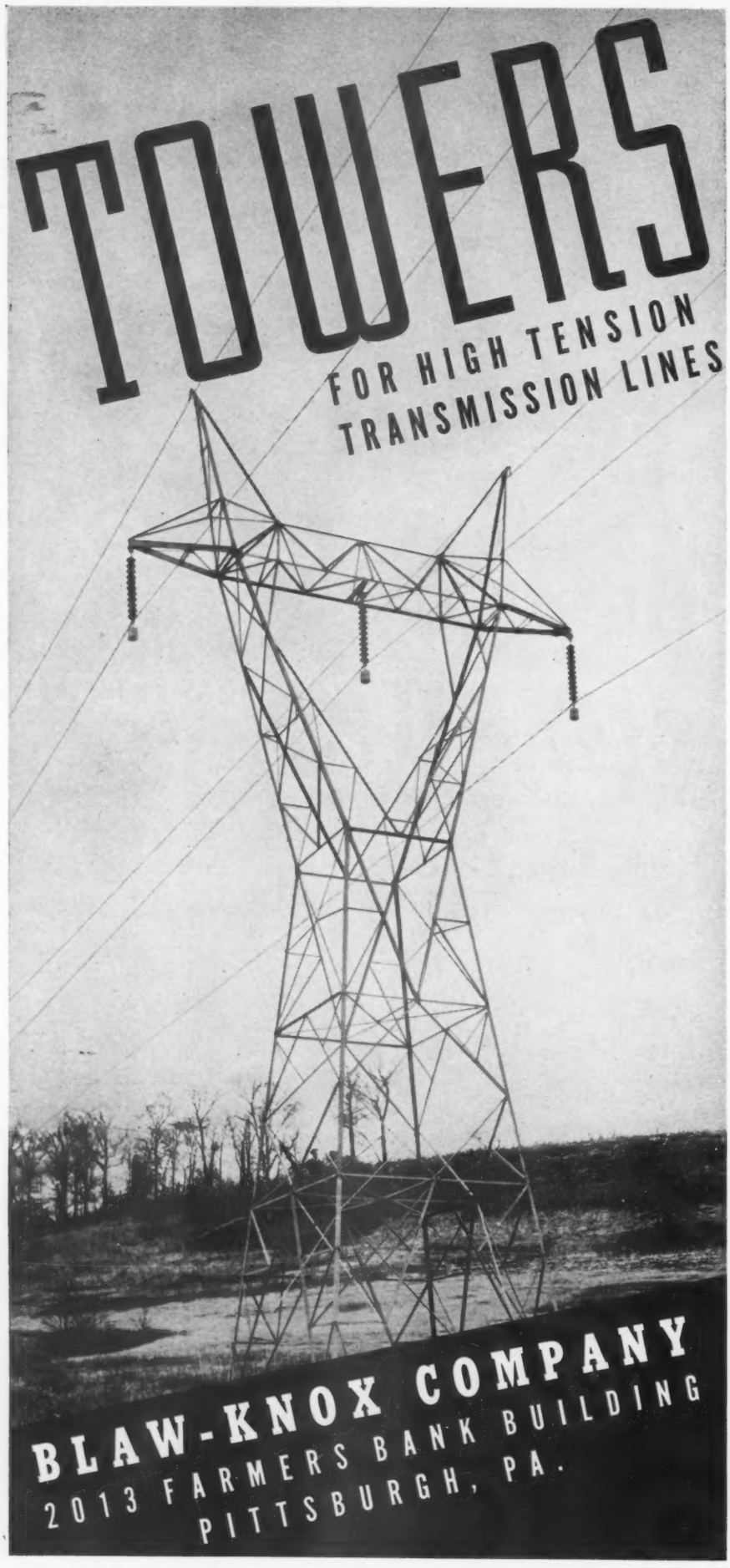
BOTTOM ROW
600 ampere, operated by manual lever.

Can be furnished in various capacities and voltages. Essentially a safety switch, incorporating modern practice in safe operation. Many designs available to fit all switching conditions.

•

Send your problems to

ELECTRIC POWER EQUIPMENT CORP.
412 North 18th Street
PHILADELPHIA, PA.



Municipal Plants

REDWOOD CITY, CALIF.—City councilmen have voted 4 to 3 for preparation of an ordinance setting November 2 as the date when a proposal to issue $575,000 in general obligation bonds to purchase distribution facilities of the Pacific Gas & Electric Company will be placed before the voters. A two-thirds majority is required for passage. The measure proposes purchase of energy from Pacific Gas & Electric. The $575,000 represents the $488,000 valuation set by the California Railroad Commission, $37,000 for subsequent improvements, $50,000 for operating capital and miscellaneous expenses.

ENGLEWOOD, COLO.—Suit to void the recent election in which a proposal to establish a municipal electric system was defeated has been filed in Arapahoe County Court. Numerous claims of illegality are made in the petition filed. The complaint declares many were allowed to vote who had no such right, under a law which specifies only taxpayers can cast a vote in such elections. It is claimed the Colorado Central Power Company issued false and misleading statements that resulted in many persons not voting. The petition asks that either the court order a new election or that ballot boxes be opened and a determination be made of the legality of the votes cast. The proposal to establish a municipal plant lost by a vote of 486 to 785.

CLEARWATER, FLA.—A new demand that the Florida Power Corporation reveal to the city the price it will demand for sale of its power distribution system has been made. The city asked the utility to name a price last August.

NEWCASTLE, IND.—Indiana Supreme Court has held that the city acted illegally in attempting to expand its municipal light system to serve domestic and industrial consumers. The court reversed action of the circuit court at Newcastle, which had refused to grant an injunction to the Public Service Company of Indiana to prohibit the expansion. At the time of the trial the city was serving many customers who previously had been served by the utility. In its opinion the Supreme Court maintain that officials of the city had never taken proper steps to set up a municipal utility system. and that consequently the city was not a utility. "It is well settled," the court stated, "that, when furnishing electric energy to light its streets, buildings and public places, the city is exercising a governmental function, but that when it furnishes and sells energy for domestic and commercial purposes it acts as a private business corporation and, in the latter case, it is subject to the rules governing private corporations." The ruling further said: "There never was an election upon the question of whether the town or city should engage in business as a public utility and no certificate of convenience and necessity ever was applied for or procured from the Indiana Public Service Commission authorizing the city to engage in business as a public utility."

MIDDLESBORO, KY.—Kentucky Utilities Company has asked a restraining order to prevent the city of Middlesboro from erecting a power distribution system or for taking steps toward obtaining TVA power. In a petition filed in the Bell Circuit Court the power company asked that the Mayor and commissioners be restrained from selling or offering for sale $175,000 in revenue

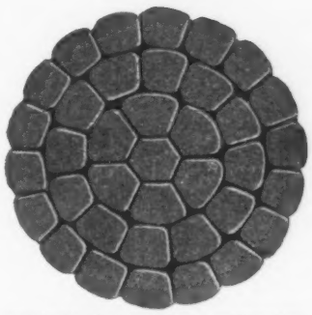
Now Available in GENERAL CABLE

VARNISHED CAMBRIC and RUBBER Insulated Power Cables

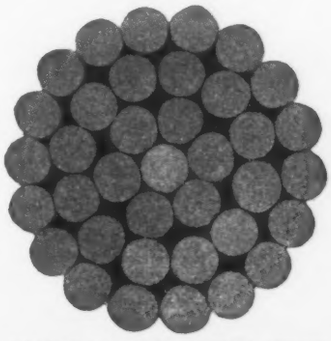
IN A RANGE OF SIZES FROM NO. 1 A.W.G. TO 1,000,000 C.M.

COMPACK STRAND CONDUCTORS

REG. U.S. PAT. OFF.



500,000 C.M. COMPACK STRAND
(enlarged 2x)
0.736" ACTUAL DIAMETER



500,000 C.M. CONCENTRIC STRAND
(enlarged 2x)
0.814" ACTUAL DIAMETER

An improved construction developed by General Cable Corporation and in standard use for several years past by this and all other manufacturers of

PAPER INSULATED POWER CABLES

Its minimization of voids between individual wires and smooth surface configuration result in many advantages, including **SMALLER OUTSIDE DIAMETER** and **LOWER A.C. RESISTANCE**

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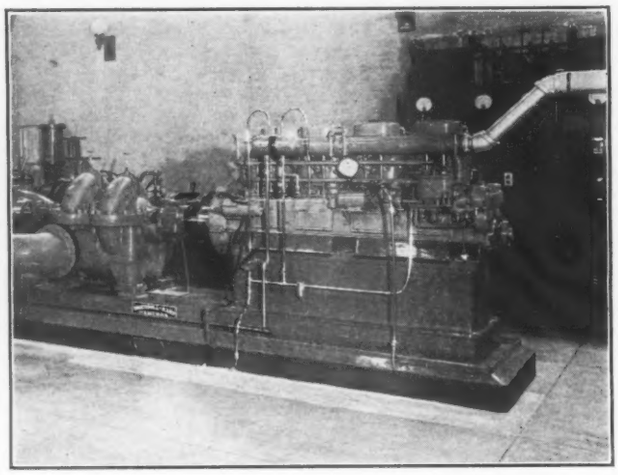
Power Failure

IS NOT ALLOWED
IN 12% OF AMERICAN CITIES

They are guarded by

STERLING HIGH DUTY INTERNAL COMBUSTION ENGINES



As a standby in emergency, Fort Dodge, Iowa employs a Cameron centrifugal pump driven by a Sterling Dolphin C-8 cylinder 240 H.P. engine running 1200 R.P.M.

12 to 565 B.H.P.
Gas or Gasoline

STERLING ENGINE COMPANY

Home office and plant
1270 Niagara Street
Buffalo, N. Y.

Dept. C-2

Branch Office
900 Chrysler Bldg.
New York, N. Y.

bonds for the building of the system. The fight between the company and officials of Middlesboro has been smoldering for several weeks following defeat of all municipal power advocates who were candidates at the August primary. It was contended in the utility's petition that the new TVA contract offered the city calls for a minimum payment the first year of $15,000; $40,000 the second year and $60,000 the third year. The petition then states that the requirements for the third year and thereafter are incapable of being met by the city. The largest amount ever consumed was 4,828,400 kw.-hr. in one year and the new contract would call for a minimum of 11,503,200 kw.-hr., it was stated. The petition further charges city officials with soliciting power contracts from coal companies outside the city limits, and that this is illegal.

COLUMBUS, MISS.—Citizens have voted to issue $281,000 in bonds to buy or build a distribution system paving the way for use of TVA power. The voting was in two divisions. The vote to issue $84,000 in bonds to build a system to distribute power to public buildings, street lights and other municipal uses stood at 689 to 74. The vote for issuing $197,000 in bonds to build a system to service domestic and commercial customers was 661 to 71.

READING, PA.—Report showing a municipally owned electric generating and distributing plant to serve all city consumers, domestic, commercial and industrial, would cost the city $4,750,000 has been filed with City Council by Burns & McDonnell Engineering Company. Although the report has not yet been adopted, city officials said they may place on the November 2 general election ballot a proposal to issue bonds to cover the cost of such a plant. The report stated that the plant would completely pay for itself in fifteen years. E. H. Werner, vice-president and general manager of the Metropolitan Edison Company, has given notice his company will vigorously combat any municipal ownership plan. The company's plant in Reading is now being enlarged at a cost of approximately $3,000,000.

ETOWAH, TENN.—Citizens have gone on record as favoring a $400,000 municipal bond issue for the purpose of acquiring a power system to distribute TVA energy. George C. Bell, vice-chairman of the city board of commissioners, said the official count of ballots cast in the recent referendum showed 279 favored the proposal and 266 disapproved.

LENOIR CITY, TENN.—City was granted the right to engage in the power business and to contract for TVA power in a decree issued recently. Chancellor James H. Wallace rendered his decision in favor of the city in the injunction suit of the Tennessee Electric Power Company vs. the city and the TVA. Negotiations with TVA are already under way, officials said, and an early connection with the TVA lines is expected. The city has owned its distribution system since 1930.

CLARKSVILLE, TENN.—A new restraining order issued against the city by Chancellor Sam A. Marable has blocked at least temporarily the signing of a TVA contract by the city. The restraining order was asked by the Kentucky-Tennessee Light & Power Company on the same day that its injunction against the city was dismissed in federal district court at Nashville. The power company had petitioned that the suit be dismissed without prejudice. Hearing of

PUT all available light in your plant to work. Turn wasted foot-candle power into profitable illumination with Pittsburgh Glorified Light Products.

The world's leading experts on light control have perfected three Glorified Light systems that convert raw light—both natural and artificial—into safe, efficient, practical illumination. Amazing results are accomplished by refinishing walls and ceilings with Pittsburgh Glorified Light Paints.

You'll find that the new lighting conditions brought about by these wonderful finishes will improve morale, reduce labor turnover, cut down accidents and speed up production *. . . at no increase in current costs.*

Find out how this great development in industrial lighting will affect *you.* Send today for our instructive book, "Glorified Light." It will show you many scientific short-cuts to more profitable production. Simply mail the coupon below for your free copy—*now.*

Pittsburgh Plate Glass Company, Paint Division, Pittsburgh, Penna.

Copr. 1937 Pittsburgh Plate Glass Co.

Three Ways to Use Glorified Light Products

THE SNOLITE SYSTEM—for all normal interior surfaces.

THE SNOTEX SYSTEM—for all abnormal interior surfaces except fungus growth. It resists discoloration from humidity, fumes, gases and lack of daylight.

THE FUNGUSIDE SYSTEM—to effectually retard the growth of fungus. It is valuable wherever bacteria and fungus must be continually combated.

SEND FOR THIS BOOK

PITTSBURGH PAINTS

Smooth as Glass

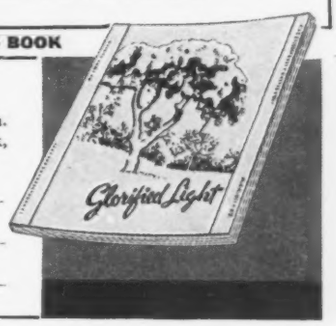
COMPLETE LINE OF STRUCTURAL MAINTENANCE FINISHES

Pittsburgh Plate Glass Co.
Paint Division, Dept. EW10 Pittsburgh, Pa.
Please send me, free, your new book, "Glorified Light".

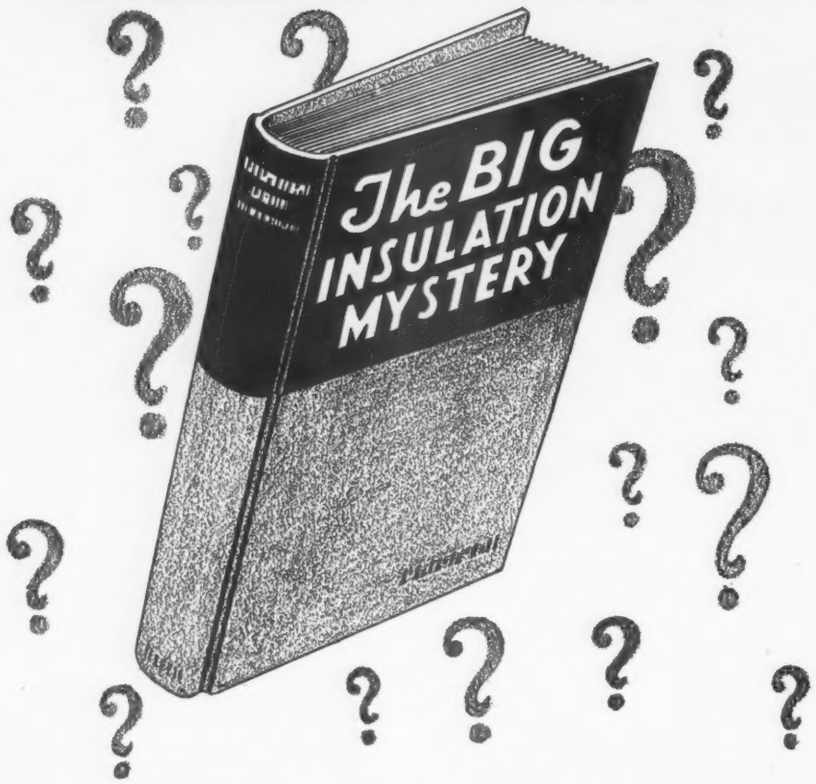
Name_____

Address_____

City_____ State_____



INSULATION HEADQUARTERS



In our files are enough insulation "mysteries" to fill a book—countless numbers have been solved by Continental-Diamond engineers in the course of routine experiments for various customers. There are yet many more difficult insulation jobs to tackle and our technicians would welcome the chance to get busy on your particular problem. In all probability they can point out changes which may cut production costs and step up performance efficiencies. This service is gratis and involves absolutely no obligation on your part. A letter briefly setting forth your requirements will put us to work at once.

CONTINENTAL-DIAMOND FIBRE CO.

Newark, Delaware

Represented in Canada by DIAMOND STATE FIBRE CO. OF CANADA, LTD., TORONTO

DILECTO

A laminated plastic, commonly known as phenol fibre, made in sheets, rods and tubes or fabricated parts to specifications. Has high electrical insulation properties, great resistance to water, practically unaffected by oil or mild acids. It is a strong, tough material with a wide application for use in connection with modern electrical appliances.

DIAMOND VULCANIZED FIBRE

A tough, economical, insulating material made in standard sheets, rods and tubes. Can be readily fabricated or formed. A material of countless applications.

VULCOID

A thermo-plastic, non-hygroscopic insulating material made in standard sheets, rods and tubes. It is strong and tough, has good electrical insulating properties and is readily fabricated.

MICABOND

Thin splittings of mica bonded together with specially developed binders into standard plates, tubing or in formed rings, punched and sawed segments or other special parts. Micabond has high dielectric strength, is practically unaffected by acids, has high heat and moisture resistance, is readily punched, sawed or formed.

CELLULAK

A laminated form of insulating tubing, possessing extremely high dielectric properties, and marked resistance to flash-over.

DILOPHANE

A translucent, laminated plastic in colors. It provides perfect light diffusion, is not inflammable, and is manufactured in practically any color imaginable with either a glossy or dull finish.

the plea for an injunction against the city, which omits TVA as joint defendant, is set for October 29.

ARLINGTON COUNTY, VA.—Frank C. Hanrahan, manager of Arlington County, said a survey will get under way to determine the feasibility of establishing a publicly owned and operated power system in the county. Wiley & Wilson, consulting engineers of Lynchburg, have been retained to conduct the study.

SUPERIOR, WIS.—An order issued by Circuit Judge W. R. Foley seeks to stop purchase of the Superior Water, Light & Power Company. In effect, the court's opinion holds that the city has authority to proceed under the original condemnation proceedings for purchase of the three properties owned by the utility, but that including the purchase of the Northern Power Company's electric property in the same proceedings is not legal because no condemnation proceedings were ever started covering Northern Power's property.

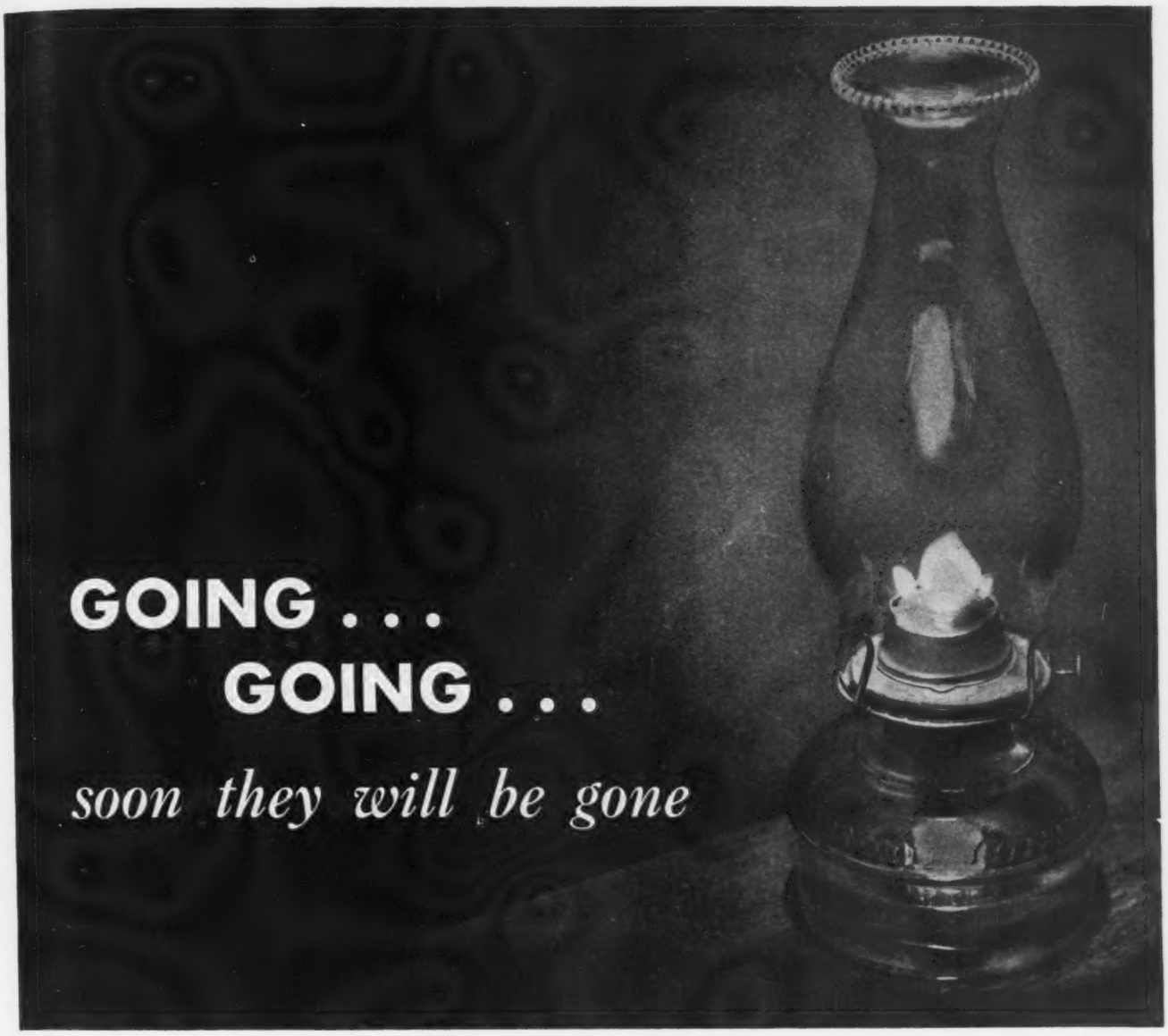
Recent Rate Changes

MISSISSIPPI POWER & LIGHT COMPANY has announced that its urban residential electric rate, known as a promotional rate and made effective in June last year became available to all urban customers about October 1. The rate will replace what is known as the immediate rate made effective in 1933. The present reduction is the fifth since 1925. The average rate per kilowatt-hour for residential service that the company received in 1925 was 13.6 cents and for the 12 months ended June, 1937, this was decreased to 4.58 cents or 67.2 per cent. Present reduction amounts to approximately 15 per cent.

OKLAHOMA GAS & ELECTRIC COMPANY'S rate reduction for the territory served in northwest Arkansas has been approved by the Arkansas State Utilities Commission. The rates became effective as of October 1. The minimum charge remains at $1 for 10 kw.-hr. Twenty kilowatt-hours will cost $1.60 under the new rate, compared to $1.59 under the old schedule, but 25 kw.-hr. will cost $1.90, as compared with $1.91, and 50 kw.-hr. will cost $2.80, compared with $3.36 under the old schedule.

NEW YORK PUBLIC SERVICE COMMISSION has received revised electric rate schedules from a number of municipal plants. Among the cities filing are the following: Rouses Point, annual reduction $2,800; Delevan, $450; Savannah, $300; Springville, $8,200; Marathon, $600; Green Island, $11,775; Dunkirk, $10,000; Wellsville, $4,742; Richmondville, $2,730.

FLORIDA POWER & LIGHT COMPANY has announced a new rate schedule for commercial consumers. The reduction is expected to make the new rates available to approximately three times as many commercial customers as are now being served under the old rate and will effect a saving in excess of $411,000. The schedule follows: Flat charge, 32.5 cents per 100 watts first 1,000 watts of contract watts; 28.0 cents per 100 watts for all additional watts of contract watts; energy charge, 5.0 cents per kilowatt-hour first 6 kw.-hr. per 100 watts of contract watts; 3.5 cents per kilowatt-hour for the next 18 kw.-hr. per 100 watts of contract watts; 2.0 cents per kilowatt-hour for all additional.



ELECTRICITY is going to work for the rural population. The thousands of miles of electrical lines which are now being installed require the use of nearly every type of electrical wire and cable. Engineering problems have made new designs necessary to meet varying conditions.

We have been making electrical wires and cables for many, many years. During that time most of the problems of electrification have been put before our engineers. Our experience and research facilities combined have been successfully called upon in the development of new materials to meet changing requirements.

Look to the American Steel & Wire Company for electrical wires and cables of every description. Our reputation for quality has been built on more than a century of wire-making experience. We welcome the opportunity to be of practical assistance to you in working out your needs for electrical wires and cables, and we are able to supply these needs with products that will give complete service and economy.

American Steel & Wire Company Products for Rural Electrification Projects

Galvanized Steel Conductors · Guy and Messenger Wire · Bare Copper Wire and Strand · Reliance URC Weatherproof Wire · Copperweld-Copper · Service Entrance & Drop Cables · Underground High Voltage Primary Cables · Overhead Concentric Cables · Rubber Covered Wires

ELECTRICAL WIRES AND CABLES

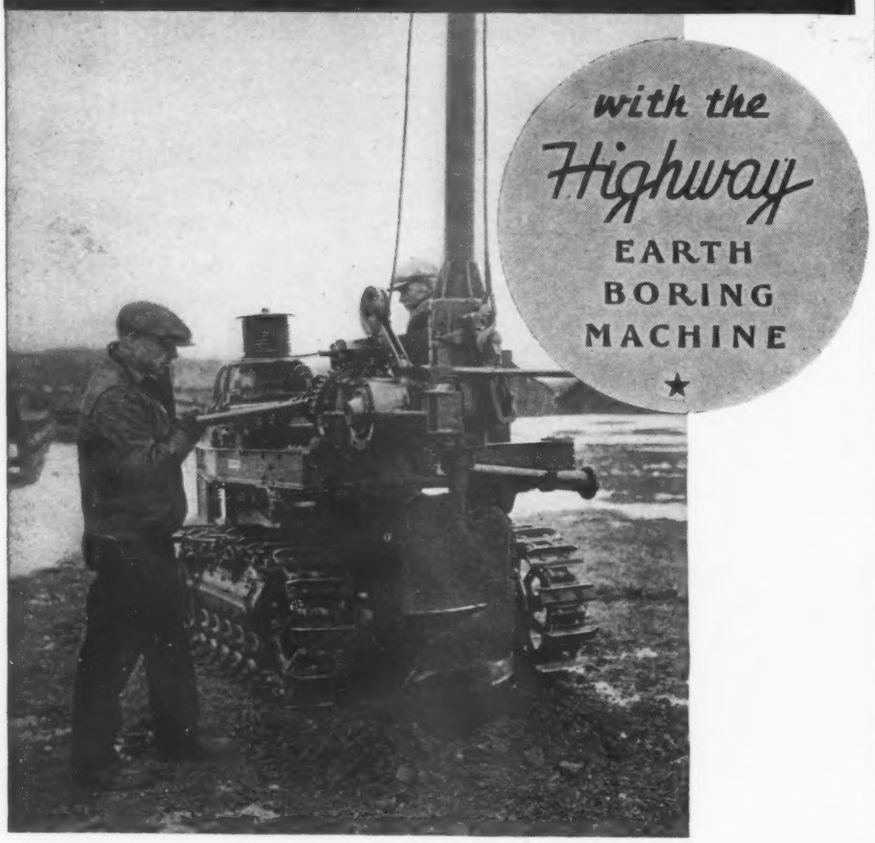
AMERICAN STEEL & WIRE COMPANY

Cleveland, Chicago and New York

Columbia Steel Company, San Francisco, *Pacific Coast Distributors* · United States Steel Products Company, New York, *Export Distributors*

UNITED STATES STEEL

DIG THROUGH FROZEN GROUND



BUILD POWER LINES
THIS FALL AND WINTER
AT LOW COST

This dependable tool gives utilities an opportunity to make greater savings than ever before in the cost of setting poles. This is even true in winter time when ground conditions are tough. The Highway reduces the time element in every operation and lightens the amount of manual labor. It adds a higher degree of safety and is of great value in cutting the time for completing new construction programs in any season of the year. With the Highway mounted on truck or tractor you can bore at difficult angles and in hard-to-reach places. There are many types and sizes available. Prepare now for low cost winter line construction with a Highway Earth Boring Machine.

HIGHWAY TRAILER CO.
EDGERTON WISCONSIN

Sales Opportunities

COLUMBUS, NEB.—Loup River Public Power District, 2307 Thirteenth Street, Columbus, Harold Kramer, secretary, receives bids until October 20 for equipment for power substations at Norfolk, Neb., and other points, including switchboards of duplex enclosed steel cabinet type, relays, meters and other apparatus. Plans are maturing for new transmission line from Columbus to Lincoln, Neb., and for primary and secondary lines for rural service in parts of Platte County, including outdoor power substations, totaling about 350 miles. Harza Engineering Company, 205 West Wacker Drive, Chicago, Ill., is consulting engineer.

BALTIMORE, MD.—Owens-Illinois Can Company, Boston and Linwood Avenues, plans installation of motors and controls, regulators, conveyors and other equipment in connection with extensions and improvements in plant. Cost close to $100,000. Francisco & Jacobus, 511 Fifth Avenue, New York, N. Y., are architects and engineers. Company is affiliated with Owens-Illinois Glass Company, Toledo, Ohio.

HAZARD, KY.—Kentucky & West Virginia Power Company, Hazard, plans transmission and distributing lines for rural electrification in group of fourteen counties in Eastern part of State, totaling about 225 miles, with outdoor power substations and service facilities. Cost close to $225,000. Application has been made for permission.

COTTON VALLEY, LA.—Octane Oil & Refining Company, Longview, Tex., Sylvester Dayson, president, plans installation of motors and controls, transformers and accessories, regulators, conveyors, electric pumping machinery and other equipment in new multi-unit oil refining plant at Cotton Valley. A power house will be built. Cost over $750,000. Work is scheduled to begin soon.

PLAINVIEW, ARK.—Arkansas Power & Light Company, Pine Bluff, Ark., has plans maturing for new transmission line from Plainview to Gravelly, Ark., with similar power line in Carden's Bottoms district to Centerville, Ark., and vicinity, and line from Dover to Hector, Ark., with distributing lines for rural electrification, with outdoor power substations and service facilities. A fund of $325,000 has been secured through federal aid for this and other rural electrification, to be increased to $500,000 at later date. Work is scheduled to begin soon. Company has secured contract from Southern Kraft Corporation, Camden, Ark., for additional power supply at mill and will extend transmission lines and build new power substation at mill site, with installation of transformers, switchgear and accessory equipment. Cost about $60,000.

WILLOUGHBY, OHIO—Ohio Rubber Company, Ben Hurr Avenue, plans installation of motors and controls, conveyors and other equipment in new three-story addition to mill, for which superstructure will begin soon. Cost close to $100,000.

WAVERLY, IOWA—Receives bids until October 19 for equipment for extensions in municipal electric power plant, including three diesel engine-generator units switchgear, transformers, motor controls and complete auxiliary apparatus. Cost about $184,000. Young & Stanley, Inc., Muscatine, Iowa, is consulting engineer.

YAZOO CITY, MISS.—Yazoo Valley Electric Power Association, Yazoo City, has

OCTOBER ELECTRICAL CONTRACTING BREAKS ALL-TIME RECORD

October Electrical Contracting broke through for an all-time record with 115 pages of advertising. McGraw-Hill releases this information not in the spirit of boasting, but because it seems conclusive proof that Electrical Contracting offers a profitable means of selling over 15,000 big buyers of electrical equipment.

NEWS

FOR ELECTRICAL MANUFACTURERS

—and don't forget

REPORT OF CONVENTION ISSUE

NOVEMBER, 1937

One of the best sales producers of the year!

ELECTRICAL CONTRACTING

Monthly

Covering

ENGINEERING • INSTALLATION • MAINTENANCE

OF EVERYTHING ELECTRICAL

Reaches over 15,000

ELECTRICAL CONTRACTORS

doing Industrial, Commercial and Residential Work

INDUSTRIAL PLANT CHIEF ELECTRICIANS

MOTOR SERVICE SHOPS

ELECTRICAL INSPECTORS · · ELECTRICAL ENGINEERS
ELECTRICAL MEN IN COMMERCIAL BUILDINGS

Serving 4 major markets for electrical products

A McGRAW-HILL PUBLICATION · 330 WEST 42nd ST., NEW YORK CITY

Those Singing Wires mean VIBRATION

Put Your Towers Up With the Nut that Can't Shake Loose

For fast, permanent tower erection or transmission lines, you can't beat Automatic Lock Nuts (ANCO-NUTS). The lock and nut are a single unit—nothing to lose or forget. They are locked up with an ordinary wrench and stay that way, regardless of shock or vibration, until removed purposely with a wrench. Comparable in price to the ordinary nut and lock-washer, but incomparably more secure and efficient. Successfully used for the past seven years in the Electrical Field. Made in all standard sizes, either black or galvanized, and have standard U.S. or S.A.E. thread. Write us today for samples and prices.

AUTOMATIC NUT COMPANY, INC.

LEBANON, PENNA.

★ LIGHT *the Job* WITH *Localite* ★

Specialized Engineered UNITS FOR EVERY LOCALIZED LIGHTING NEED ★

FOSTORIA *Announces*

'CANOPY' LIGHTING UNITS

Wherever reflected glare is a problem, the new Fostoria Canopy Lighting Unit provides completely diffused, high intensity illumination. For such tasks as bright metal scribing, drafting, typesetting, engraving, polishing, hard candy mixing, minute inspection work, etc. A complete variety of models is available for specific applications. Full information will be furnished promptly on request.

DESCRIPTIVE BROCHURE FREE... A valuable handbook of localized lighting.

THE FOSTORIA PRESSED STEEL CORP., FOSTORIA, O.

plans maturing for primary and secondary lines for rural electrification in Yazoo, Warren, Holmes and neighboring counties, totaling about 125 miles, with outdoor power substation and service facilities. Fund of $126,000 has been secured through federal aid.

CHICAGO HEIGHTS, ILL.—Gold Seal Asphalt Roofing Company, Minneapolis, Minn., plans installation of motors and controls, conveyors and other equipment in new multi-unit plant at Chicago Heights, on which work will begin soon. Cost over $100,000.

OAKLAND, MD.—Plans extensions and improvements in electrical distribution system, including new power substation in Terra Alta district. Cost about $50,000.

LANCASTER, WIS.—Grant County Rural Electrification Association, Lancaster, has plans nearing completion for primary and secondary lines for rural electrification in parts of Grant and neighboring counties, totaling close to 200 miles, with power substations and service facilities. Fund of $200,000 is being secured through federal aid. E. B. Wayts, Tenney Building, Madison, Wis., chief engineer, Wisconsin Rural Electrification Administration, is engineer in charge.

CHICAGO, ILL.—Glidden Company, 5165 West Moffat Street, plans installation of motors and controls, regulators, conveyors and other equipment in new three-story addition to paint and varnish plant. Cost over $200,000. Work on superstructure will begin at early date. Main offices of company are at Berea Road and Madison Avenue, Cleveland.

OAKLAND, CALIF.—Pacific Gas & Electric Company, San Francisco, has begun superstructure for addition to steam-electric generating station at First and Grove Streets, Oakland, to be used for expansion in turbine room. Additional equipment will be installed.

ARTESIA, N. M.—Central Valley Electric Corporation, Artesia, has plans maturing for primary and secondary lines for rural electrification in vicinity of Artesia, totaling about 85 miles, and for steam-electric power plant at Artesia. Entire project will cost about $260,000.

•

Portland Hearing Postponed

Upon the request of the petitioner, the Federal Power Commission has postponed until October 25 the hearing scheduled for September 27 on a petition by the Portland General Electric Company, Portland, Ore. The petition asks rehearing, reargument and reconsideration with respect to Part 2 of the commission's order of May 4, 1937, which denied an application by the company for amendment of license of its project, known as the Oak Grove project, to change the designation of certain transportational facilities used in connection with the project from "project railroad" to "project truck road."

Three Years of Load Building

[*Continued from page 70*]

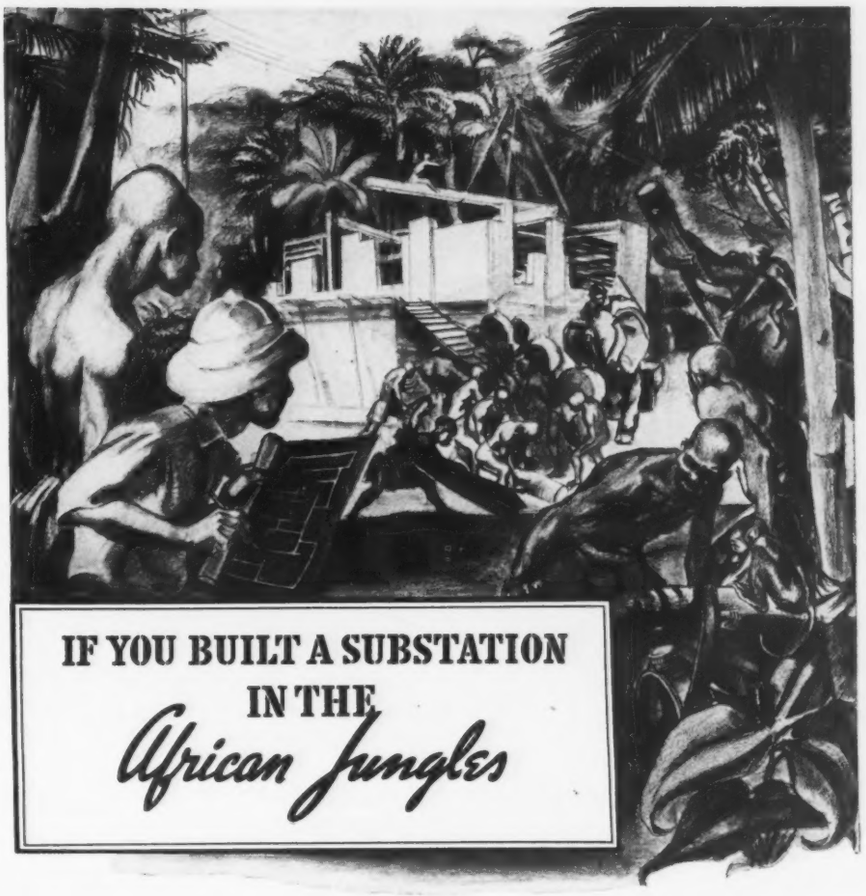
has no reference to dealer costs. However, there has been a notable increase in E.A.R. from the promotion of lighting. Home lighting has increased from $79,000 E.A.R. reported in 1934 to $165,000 in 1935 and in 1936 reached a total of $326,000. The budget in 1937 calls for $450,000 in E.A.R. from home lighting.

Commercial lighting has had a somewhat proportionate growth from $283,000 in 1934 up to $610,000 in 1936, with $725,000 budgeted in 1937.

E.A.R. from power sales has increased from $948,117 in 1934 to $1,563,000 in 1936. Costs of securing business have decreased from an average of 40 cents in 1934 to 30 cents in 1936.

The gains made in power business secured by individual companies are shown in chart 6. The Middle West average indicates E.A.R. amounting to $9.52 per customer has been secured from commercial lighting in the past three years (see chart 7). In most instances 1936 was by far the most successful year in the promotion of commercial lighting. In the past three years commercial lighting revenues have shown a very satisfactory gain, and while undoubtedly improved business conditions contributed to the showing, the work of the commercial lighting salesmen has played an important part. The actual revenue from commercial lighting for the twelve months ended November 30, 1936, shows an increase of 27½ per cent over the revenue secured in 1933. Of this increase nearly one-half may be credited to load-building effort, as appears from the sum of 1934, '35 and '36 E.A.R. as shown in chart No. 5. During the same period kilowatt-hour sales to commercial lighting customers have increased by 51½ per cent, as shown in chart 2.

The amount of merchandise sales per customer has a direct bearing on the production of E.A.R., particularly in small towns where a large percentage of electric devices is distributed by the utility (see chart 8). Of course the sale of merchandise which uses little energy, or which costs the customer a considerable sum to buy, might build up large merchandise sales without substantially increasing revenue or consumption;



YOU'D have to contend with the problem of thermal expansion—blazing heat by day . . . bitter cold by night. Then, too, settling foundations and the shock of breaker operations would menace your transformer bushings . . . and replacement parts might as well be in another world!

You'll probably never build a substation in the heart of "darkest Africa." Yet, right here at home, thermal expansion, shock and strain can cause costly damage to unprotected equipment!

Burndy Expansion Connectors offer a positive safeguard against these hazards. Their high copper content alloys combine strength with corrosion-resistance and high conductivity. Their patented design features eliminate the possibility of failure due to vibration and overload. Specify Burndy Expansion Joints . . . *confidently!* Burndy Engineering Co., Inc., 459 East 133rd Street, New York, N. Y.

Type XD

BURNDY
CONNECTORS

Announcing
The **NEW**
PEMCO 600-R
Luminaire
with Holophane
Refractor

Apply these
ADVANTAGES
to Your System:

1. Low in first cost.
2. Lighter in weight for easy low cost installation.
3. Strong pressed glass refractor resists breakage — protects lamps—reduces maintenance.
4. Reflector-refractor construction sends more light downward to street.
5. Improved asymmetric distribution permits wider spacing—fewer units—lower costs.
6. Smooth outer surfaces for easy cleaning.
7. Shielded on house side for residence areas.
8. All lamp sizes to 10,000 lumen or 500-watt.

PHILADELPHIA
ELECTRICAL & MFG. CO.
1206-36 N. 31st St.,
PHILADELPHIA, PENNA.

likewise, merchandise sales made by the company which actually represent sales that would be made by the dealer do not contribute to load building as do sales made by the utility which would not be made by others. While merchandise sales volume alone does not tell the complete story of domestic load building, it is to be noted that in general those companies having the largest merchandise sales also have the largest gain in domestic consumption.

Chart 9 shows the E.A.R. which the companies have estimated as resulting from merchandise sales by the company and merchandise sales by the dealer in the past three years. E.A.R. from dealer sales comes largely from refrigerators and other accepted devices, while E.A.R. from company merchandise sales comes from ranges, water heaters and refrigerators, as is shown in other charts to follow.

From this analysis of the general load-building accomplishments of the Middle West companies are seen some of the reasons behind the addition of increment loads at such figures as 3.09 cents for residential and 3.17 cents for commercial business.

Residential load building is so important to the industry at this time that Middle West's residential experiences will be shown in similar chart form in a succeeding issue.

•

Gets 2,000 New Street Lights

Two thousand more street lights, designed by General Electric engineers to meet the city's requirements, will be used by the Detroit Public Lighting Commission in its main artery lighting modernization program. Three thousand of these units now in use have replaced arc lamps and have increased the illumination on the street about six times, it is claimed.

•

Start Greist Ads in October

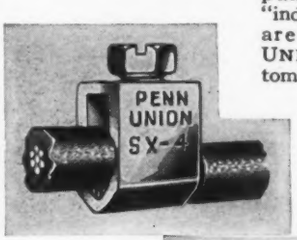
Greist Manufacturing Company, New Haven, Conn., will break its first consumer advertising campaign in October, using the theme "Corrected Light" for high visual acuity, based on the performance of its "White Knight" lamps and other units using the "Celestialite" luminaire. Portable lighting equipment for every office purpose will be offered. Williams & Saylor, Inc., is the agency.

You're sure it's
Dependable—
if it's a PENN-UNION conductor fitting—

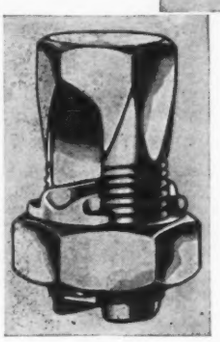
Every item carefully designed, and thoroughly tested.

Never any question as to reliability of the connection—mechanically and electrically.

That's why the leading utility companies and "industrials" are PENN-UNION customers.



More than 6,200 items



The line is complete.

Fittings for every type of electrical connection.

Any combination of tube, bar, cable and wire.

Write for catalog.

Sold by leading jobbers

PENN-UNION
ELECTRIC CORPORATION
ERIE, PA.

You'll find it in the *complete* line—

PENN• UNION
Conductor Fittings

Rural Construction Contracts Awarded

REA has recently announced that construction contracts have been signed as follows:

CALIFORNIA—Surprise Valley Electrification Corporation has awarded a construction contract to the Parker-Schramm Company, Portland, Ore., to build 349 miles of line. Low bid was for $384,252.

INDIANA—Wabash County Rural Electric Membership Corporation, contract to Contracting & Material Company, Chicago, 270 miles of line. Low bid $236,465. Hancock County Rural Electric Membership Corporation, contract to Harold Tharp, Lebanon, Ind., 321 miles of line. Low bid, $288,588.

IOWA—Maquoketa Valley Rural Electric Corporation, contract to Marshall Electric Company, Marshalltown, Iowa, 286.6 miles of line. Low bid, $251,111.

NEBRASKA—Southern Nebraska Rural Public Power District, contract to Federal Engineering & Construction Company, Kansas City, Mo., 430 miles of line. Low bid, $322,378. Eastern Nebraska Public Power District, contract to Chapin Contracting Company, Wichita, Kan., 421 miles of line. Low bid, $391,145.

NORTH DAKOTA—Cass County Electric Cooperative, Inc., contract to C. F. Lytle Company, Sioux City, Iowa, 457 miles of line. Low bid, $389,219.

TEXAS—Hill County Electric Co-operative, Inc., contract to W. E. Callahan Construction Company, Dallas, Tex., 289 miles of line. Low bid, $245,126.

Among the recent allotments are the following:

TEXAS—Co-operative to be formed, partial allotment $100,000, requested $330,000, 400 miles of line, 720 customers, San Sada, McCulloch, Mason, Concho, Coleman and Brown counties. Co-operative to be formed, partial allotment, $100,000 requested $278,000, 290 miles of line, 792 customers, Grayson and Collin counties.

ALABAMA—South Alabama Electric Membership Corporation, additional allotment $310,000, requested $818,000, 796 miles of line, 2,855 customers.

IOWA—Humboldt County Rural Electric Co-operative, additional allotment, $115,000 to complete a 259-mile project begun last year for which $130,600 was allotted.

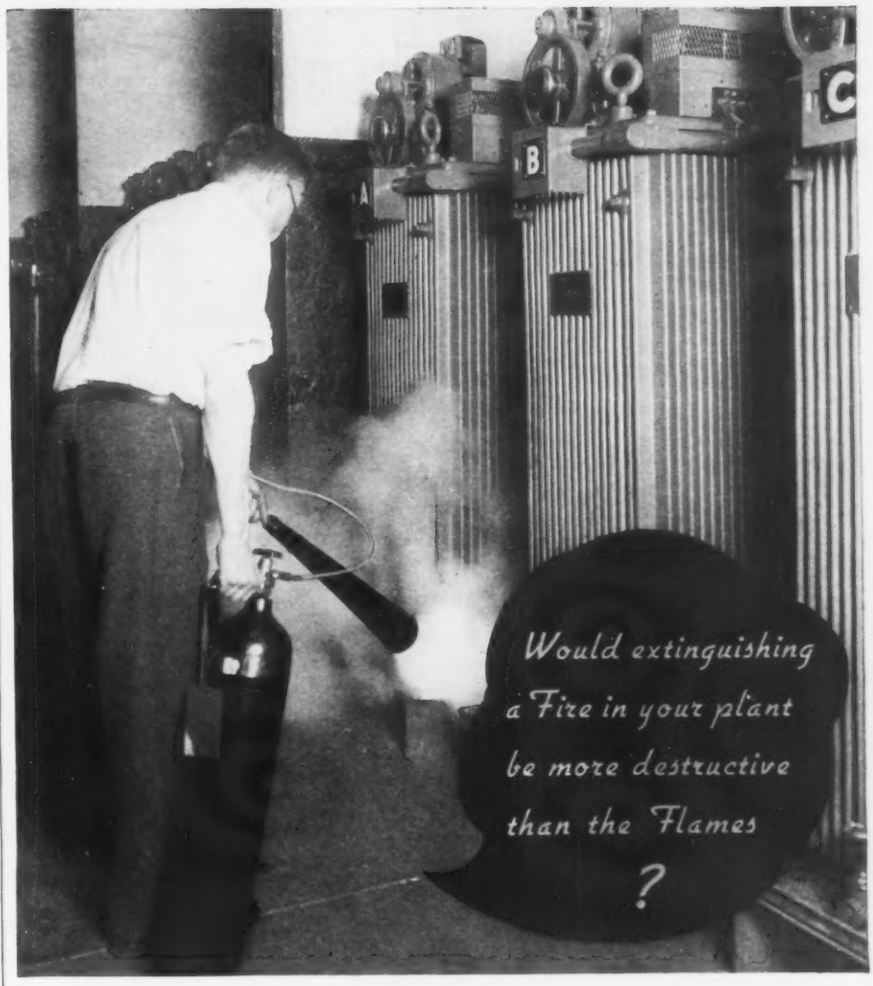
SOUTH DAKOTA—Union County Rural Power Company, additional allotment $101,000, 90 miles of line, 180 customers in Union County. Total of $206,000 now available, 197 miles of line, 500 customers.

CALIFORNIA—Co-operative to be formed in Plumas County, $283,000, 229 miles of line, 643 customers, Plumas and Lassen counties.

OREGON—Portland General Electric Company, $100,000 to build extensions to lines in Multnomah, Columbia, Washington, Yamhill, Marion and Clackamas counties, 109 miles of line, 573 customers.

WYOMING—Wyrulec Company, additional allotment $156,000, 150 miles of line, 392 customers, Goshen County. Power will be supplied by U. S. Bureau of Reclamation.

INDIANA—Marshall County Rural Electric Membership Corporation, additional partial allotment, $100,000, requested $370,000, 372 miles of line, 1,296 customers, Marshall, Kosciusko, St. Joseph, Starke, Fulton and Pulaski couties. Fayette-Union County R. E. M. C., $108,000, 111 miles of line, 398 customers, Fayette and Union counties. Rush County R.E.M.C., partial allotment $100,000, requested $385,000, 346 miles of line, 1,212



● If you depend on water or active chemicals for prevention of electrical or inflammable liquid fires you run the risk of a cure which may easily be worse than the disease. Furthermore, there is the ever present danger of the fire spreading.

The transformer fire shown was blanketed with LUX carbon dioxide gas without damage or corrosion to electrical equipment and without mess. The flame was stopped at its source immediately the gas penetrated the fire area.

Because of its instantaneous action and safety, LUX carbon dioxide has been accepted as the medium for fire protection by leading public utility companies. For complete information ask for a copy of our new brochure "LUX Makes the Difference."

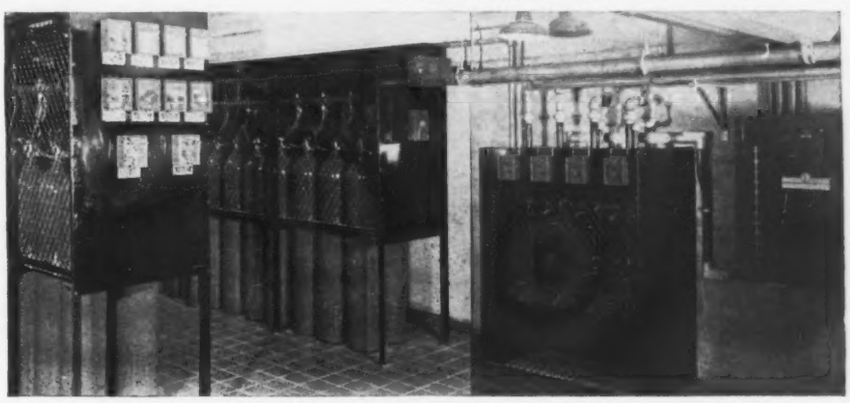
Walter Kidde & Company, Inc.

30 West St., Bloomfield, N. J.

LUX

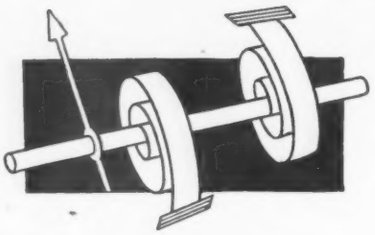
FOR ALL ELECTRICAL AND OIL FIRES

LUX system installed at Norris Dam which automatically protects power house from fire.



LINCOLN DEMAND METERS

ONLY ONE UNIT MOVES



The unit shown above consists of the center shaft, two bimetallic coils, and the pointer. This comprises the moving element of the Lincoln Maximum Demand Meter. The only motion is the slow expansion of the coils and the slow turning of the shaft.

TYPE WD

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LINCOLN METER COMPANY
SPRINGFIELD, ILLINOIS

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POWER CABLE
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"QUALITY ABOVE SPECIFICATIONS"

KENNECOTT WIRE AND CABLE COMPANY
SUBSIDIARY OF KENNECOTT COPPER CORPORATION
PHILLIPSDALE, RHODE ISLAND
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customers, Rush, Hancock, Fayette, Shelby and Henry counties. Fulton County R.E.M.C., partial allotment $150,000, requested $335,000, 304 miles of line, 1,072 customers. Wayne County R.E.M.C., additional partial allotment $150,000, requested $385,000, 368 miles of line, 1,132 customers, Wayne, Union, Fayette and Randolph counties. Noble County R.E.M.C., additional partial allotment $150,000, making total of $225,000 available. Requested $490,000, 438 miles of line, 1,696 customers, Noble, Dekalb, Kosciusko, Elkhart, LaGrange and Steuben counties.

•

WPA Building Hydraulic Lab for University of Minnesota

The Works Progress Administration is constructing, at St. Anthony's Falls, a large-scale experimental hydraulic laboratory for the College of Engineering of the University of Minnesota. Located on Hennepin Island, in the heart of Minneapolis, the laboratory will be primarily an experimental and research institution, its function being the promotion of greater knowledge of water-power use and the perfection of hydro-electric machinery.

A large turbine-testing and hydraulic machinery section and a river and hydraulic structures laboratory are planned. Discharges through the laboratory in excess of 300 cu.ft. per second may be handled, it is said. The laboratory is designed to utilize half the available head of 48 ft. for various flow experiments in open channels. It is said that this laboratory will be the only one in the United States capable of testing a full-size turbine. The federal government has approved an expenditure of more than $400,000 for the laboratory.

•

62,836 Visit Schenectady

Representatives from all walks of life and from every state in the Union were included in the 62,836 persons who visited the Schenectady works of the General Electric Company during the first six months of 1937. In addition, there were several hundred visitors from foreign countries.

•

Take Boulder Dam Power

Temporary contracts are being negotiated for small blocks of Boulder Dam power to be used by Kingman and Needles, Ariz. The power eventually is to be taken by the Metropolitan Water District of Los Angeles under its contract.

Gate Bridge Lighting Has Preassembled Standards

[*Continued from page 67*]

transformers and three miscellaneous transformers in smaller sizes. It is of interest to note that a 90-kva. capacitor is installed to improve the power factor of the entire bridge load.

Of the circuits mentioned above, that designated as supervisory consists of four No. 4 telephone circuits and eleven No. 14 conductors for supervisory purposes. On the benchboard in the substation six miniature lights are installed, two of which show whether the contactors for the magnetic valves on the foghorns are being actuated, two others show if the auxiliary globes on the airway beacons at the top of the towers are functioning, and indicate which, if either, is burned out; a fifth shows when the aid-to-navigation spare bulb is in use and the sixth when the auxiliary flasher is energized. Four microphones are located at each of the four audible fog signals. By means of a telephone jack and switches the operator in the substation can plug in and determine if each of these is operating correctly. The supervisory circuits are operated through a transformer and a 12-volt rectox rectifier.

Conduits for the various bridge circuits are all carried in rigid pipe provided with brass expansion joints located every 50 ft. The bridge is so long that a variation in length of approximately 6 ft. is expected between maximum and minimum temperatures. This expansion is taken care of in the electrical circuits by the expansion joints in the conduits and by terminating the conduits before they reach each tower in flexible bronze conduits looped between the pull box on the tower and the terminal pull box of the conduit on the span. Cables are protected with a tellurium compound rubber covering without armor.

•

California Edison Booklet on Electricity in the Home

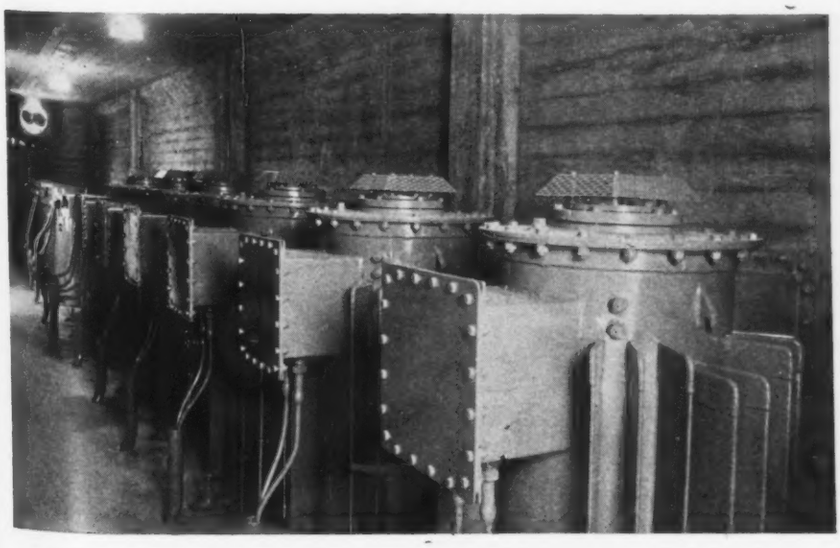
Illustrated with photographs of interior and exterior views of all-electric homes in territory served by the Southern California Edison Company, a booklet entitled "Electricity in the Modern Home" has just been issued by the company.

Booklet points out that California home owners are achieving comfort, utility and lasting charm through the use of adequate electric facilities and offers to prospective home builders the services of the company's electric home advisory department. Distribution of the booklet will be handled primarily by field men of the advisory service.

•

Italy Starts Hydro Project

An important electricity development plan calling for the construction of 90 new power stations is being undertaken in Italy. Work has already started on 79 of the new stations, Signor Gigli, Minister for Public Works, has stated.



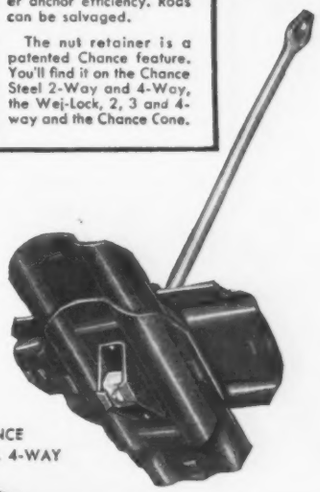
Transformer room at main substation

Pyroanol insulations fluid is used to eliminate fire hazards and minimize temperature rise of the transformers.

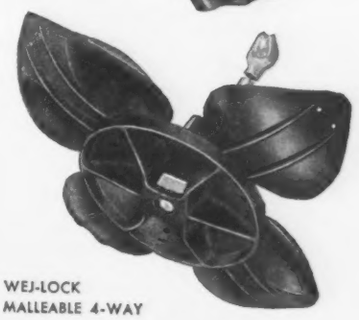
THE CHANCE PATENTED NUT RETAINER Saves TIME ENERGY MONEY

Expanding or cone anchor installations are made easier, better, quicker, and cheaper with the Chance patented nut retainer because it prevents the anchor from riding up the rod and makes it possible to keep the hole to the minimum size, giving greater anchor efficiency. Rods can be salvaged.

The nut retainer is a patented Chance feature. You'll find it on the Chance Steel 2-Way and 4-Way, the Wej-Lock, 2, 3 and 4-way and the Chance Cone.



CHANCE STEEL 4-WAY



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Commutator can be undercut a little at a time in spare moments, because there is no dismantling of rigging and brushes. Removes high mica and permits the use of most efficient type of brushes.

Light in weight. Easy to control. Cuts smoothly — no vibration, jumping or chattering. Works in restricted spaces and cuts within ¼" of the risers. For large or small Commutators and continuous heavy duty service.

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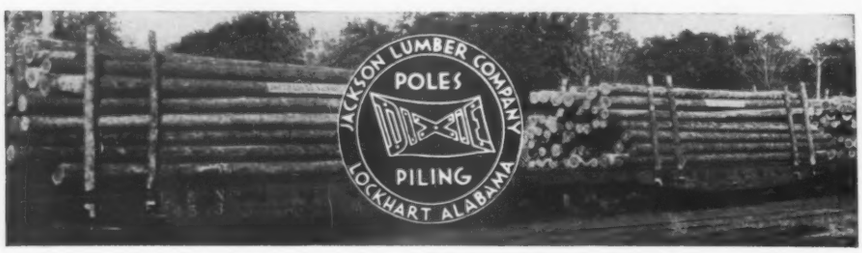
A CROSSETT WATZEK GATES INDUSTRY



Monongahela System Pushes Rural Plan

Harrison County, one of West Virginia's principal agricultural counties, is now one of the best electrified rural areas in the state as a result of line extension activities of the Monongahela-West Penn Public Service System. This company, during the last year and a half, has constructed or now has under construction more than 125 miles of new lines, bringing the advantages of electricity to more than 1,000 new customers.

The Harrison County construction is a part of a greatly expanded rural extension program of the company which in 1936 added more than 2,200 rural electricity users to its lines in north and central West Virginia and Ohio and expects to more than double that figure in 1937. Forty-five separate projects have been launched in Harrison County since January 1.

•

Texas Output Advances

Consumption of electric power in Texas during August was substantially above that of the corresponding month last year and the gain over July was considerably greater than the normal seasonal increase, figures compiled by the University of Texas Bureau of Business Research indicate.

Reports from seventeen of the largest power companies of the state show aggregate consumption of 227,000,000 kw.-hr. during August, an increase of 20 per cent over August last year, and 6.6 per cent over July. Commercial consumption increased 16.5 per cent over August last year and 4.9 per cent over July; industrial production increased 22.9 and 7 per cent over the comparable periods; residential, 16 and 4.7 per cent, and miscellaneous uses, 17.9 per cent and 10.8 per cent respectively.

•

Ask Utilities to Show Tax

The sales tax division of the Missouri Auditor's office plans to ask three St. Louis utilities to change their method of billing customers so as to provide for an itemized statement of the amount of sales tax to be collected. The suggestion will be made to Union Electric Company, Laclede Gas Light and Southwestern Bell Telephone Company.

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THE PERSONAL FACTOR

As our executive offices are here at the mill, the conditions existing in every department are always known to our officers.

Our district sales managers are in constant contact with the main office and inquiries for prices or delivery dates receive immediate attention and quick answer.

To buyers of rods, wires, and cables, we offer the product of a modern plant plus helpful personal attention.

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Kitchen Planning Promotion by Georgia Power Company

Kitchen modernization is to be offered as a free home service in the kitchen planning promotion under way with the Georgia Power Company.

Major part of the promotion will be a series of weekly advertisements in the sixteen daily newspapers throughout the company's territory, which began September 12. These advertisements will feature photographs of all-electric kitchens among company customers, together with testimonials from the housewives. A coupon inserted in the ads. will offer service of the local home economist to any one interested in planning a kitchen.

•

Staten Island Edison Asked to Cut Rates by $400,000

A rate complaint against the Staten Island Edison Corporation, filed with the Public Service Commission by New York's Mayor La Guardia asks an immediate cut of at least $400,000 a year in rates and an ultimate cut of not less than 15 per cent.

The complaint charges that electricity consumers on Staten Island have been subjected to improper overcharges of $1,750,000 in the last four years. "One-fifth of the fixed capital used in the rate base of Staten Island Edison is write-up," the Mayor contended. Company has some 46,000 customers and supplies street lighting and power to industrial concerns in addition to residential service.

•

Plant Earnings Transferred

Wisconsin Public Service Commission has approved a transfer of $60,000 from the earnings of the Manitowoc, Wis., municipal electric plant to the city general fund, declaring there was no convincing evidence that the funds would be needed for replacements or additions that would make the transfer inadvisable.

•

New Rural Loan Sanctioned

The Shenandoah Valley Electric Co-operative has received authority from the Virginia Corporation Commission to borrow $35,000 additional from the REA in connection with the building of a generating plant.

A GRIP FOR ALL NEEDS

No. 1628-5 B.
"Chicago" Grip.
Maximum opening .563.
Minimum opening .115.
Safe Load, 8,000 lbs.

Here's the new "Chicago" Grip capable of handling messenger or guy strand from 3/16 in. diameter up to 1/2 in. diameter. A genuine all purpose grip that can also be used satisfactorily on bare conductors, solid or stranded, from No. 6 to No. 4/0 seven strand copper and A.C.-S.R. up to No. 3/0. A grip that even satisfactorily handles the new three-strand "copperweld" conductor. The bronze-lined jaws prevent slippage. This new grip will afford a sure hold under all conditions, with loads up to 8,000 lbs.

DISTRIBUTED THROUGH JOBBERS

Foreign Distributor: International Standard Electric Corp., New York

The four pamphlets listed below will be sent without charge to anyone interested. Check the ones you want:

- ☐ Safety for the Pole Climber.
- ☐ Specifications on Linemen's Belts and Safety Straps.
- ☐ The Safety Factor on Linemen's Leather Goods.
- ☐ Pocket Tool Guide.

Mathias KLEIN & Sons
Established 1857 Chicago, Ill. U.S.A.
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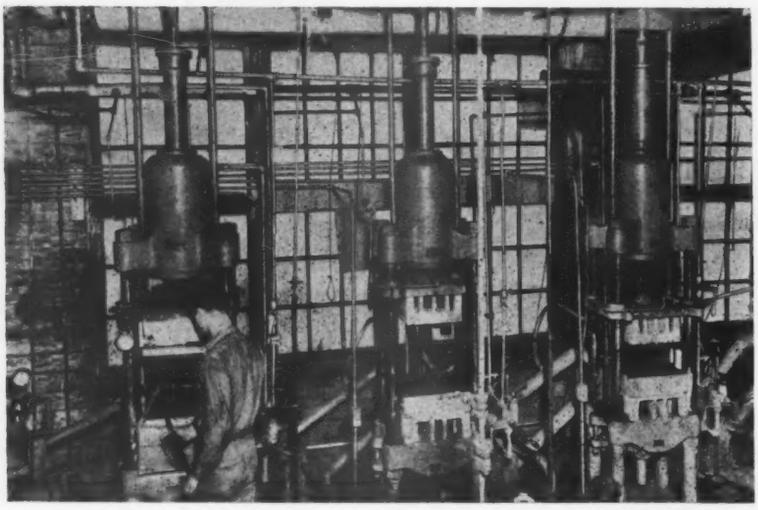
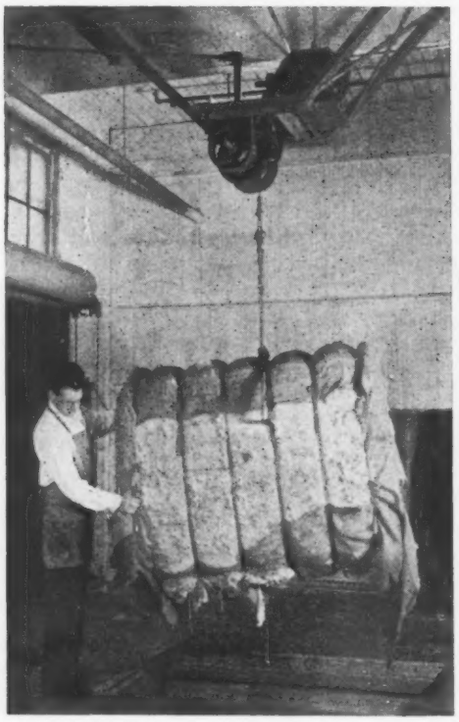
FOUND - A new way to



ELECTRIC STEAM BOILERS *save money in a St. Louis plant.*

TYPICAL CASE STUDIES FROM TIMELY IDEAS— EACH STORY DESCRIBES A PROBLEM — WHAT WAS DONE — RESULTS.

ELECTRIC MAT SCORCHER *removes hazards and improves quality in newspaper plant.*



ELECTRIC HOIST *speeds handling and reduces costs at Simmonds Mfg. Corp.*

ADEQUATE LIGHTING *reduces complaints and improves quality at Ideal Roller Mfg. Co.*

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